ARMY ORDNANCE

VOL. XXVIII, No. 148 JANUARY-FEBRUARY, 1945

The Battle for Europe
Maj. Gen. Henry B. Sayler

Old Weapons and New
Maj. Gen. C. T. Harris, Jr.

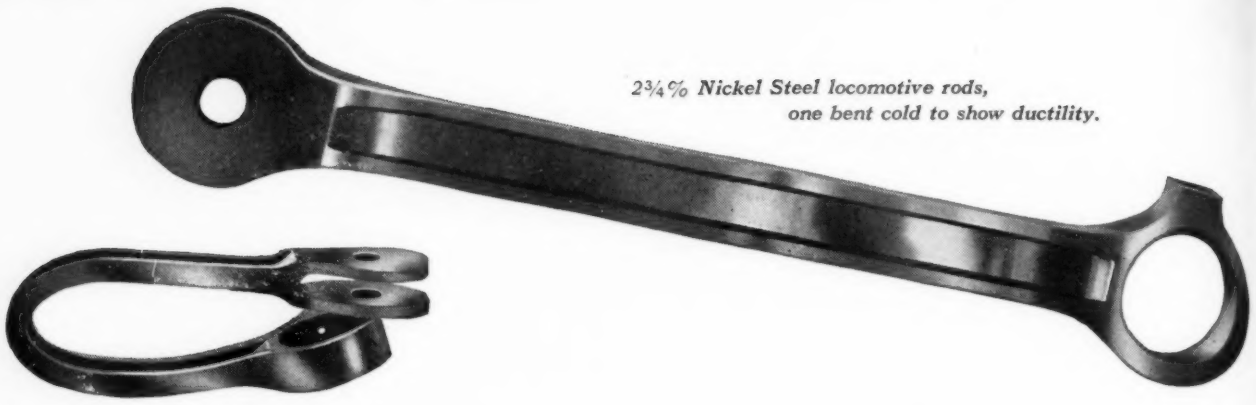
Field Service in the First Army
Col. J. B. Medaris

Incendiary Bombs
Brig. Gen. A. M. Prentiss

From Poland to Pearl Harbor
Maj. Hoffman Nickerson

Ammunition
An Editorial

A REVIEW OF INDUSTRIAL PREPAREDNESS FOR NATIONAL DEFENSE
PUBLISHED BY THE ARMY ORDNANCE ASSOCIATION, WASHINGTON, D. C.



2¾% Nickel Steel locomotive rods, one bent cold to show ductility.

QUENCHED AND TEMPERED

NICKEL STEEL

FORGINGS COMBINE

EXCEPTIONAL DUCTILITY

WITH

HIGH TENSILE STRENGTH

Composition and Typical Properties of Normalized Quenched and Tempered 2¾% Nickel Steel Rods

Description or Size	Melt Yield Pt. No. #s per Sq. In.	Tensile Strength #s per Sq. In.	Elong. % in 2 In.	Reduction in Area %	ANALYSIS					
					Car.	Mang.	Phos.	Sul.	Sil.	Ni
Main Rod....	92900	110000	25.0	64.4	.31	.78	.027	.026	.25	2.75
Main Rod....	86500	104500	25.5	65.6	.32	.86	.034	.032	.29	2.69
Main Rod....	86360	104400	26.0	64.8	.32	.86	.034	.032	.29	2.69
Main Rod....	87850	102350	26.0	66.2	.31	.89	.037	.025	.32	2.69
Front Rod....	86000	102250	25.0	67.3	.29	.82	.035	.027	.24	2.71
Front Rod....	83900	104250	25.0	66.1	.29	.82	.035	.027	.24	2.71
Front Rod....	86850	104250	27.0	66.1	.32	.86	.035	.025	.30	2.65
Front Rod....	89500	107050	25.5	65.6	.32	.86	.035	.025	.30	2.65
Back Rod....	89500	107650	25.0	62.7	.30	.79	.030	.025	.22	2.71
Back Rod....	87500	106450	25.0	65.4	.29	.82	.035	.027	.24	2.71
Back Rod....	87000	105600	25.0	65.4	.29	.82	.035	.027	.24	2.71
Back Rod....	88150	104850	26.0	66.8	.29	.82	.035	.027	.24	2.71

Specimens Taken from Mid-Section of Prolongations of the Forgings

The above table compiled by the American Locomotive Company shows the chemical compositions and mechanical properties of some normalized, quenched and tempered nickel steel front, main and back rods recently produced as replacement rods for locomotives being speeded up and rebalanced. These values are typical of replacement rod forgings recently tested by that company.

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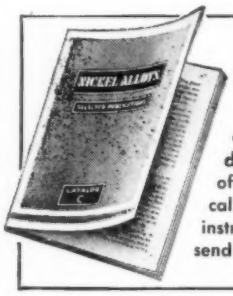

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ARMY ORDNANCE

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

Founded 1920

For Victory through Armament Research, Production, and Supply

Volume XXVIII JANUARY-FEBRUARY, 1945 No. 148

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"I hear the war's practically over... back home!"

PROBABLY it's only natural for us here at home to feel that the war's almost won, the way the good news has been pouring in.

But the war's not over for *him—not by a long sight!* And he's just one of a few million or more that will stay over there until they finish the bloody mess. Or kill time for a few months—or years—in some hospital.

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Signal Corps

River Patrol

ARMY ORDNANCE

Volume XXVIII JANUARY-FEBRUARY, 1945 No. 148

The Battle for Europe

Ordnance Service in the Continental Theater

Maj. Gen. Henry B. Sayler

MEN of Ordnance are serving on a great, hard-hitting team in the European Theater of Operations, backed up by a brilliant "backfield" at home composed of U. S. industry and the Army Ordnance Department, headed by the brilliant, dynamic Maj. Gen. L. H. Campbell, Jr. The Ordnance story in the European theater has been one of close coöperation with the Air Forces, the Ground Forces, and the other services; of local procurement in England; of two years of shrewd planning for red-letter D-day on June 6, 1944; and of the backbreaking task of following our armies on the Continent through Normandy, Cherbourg, Brittany, Paris, the Seine, Château-Thierry, the Marne, Belgium, and now through the Siegfried Line into Germany.

Millions of tons of ordnance, including every one of the bits and pieces in the whole Ordnance catalogue of over 350,000 separate items, have provided General Eisenhower's armies with the devastating firepower and sure-footed mobility that is so necessary to hurdle all the Nazi obstacles and bring "unconditional surrender."

The Ordnance job in the ETO has been one of *service* to every soldier; for every doughboy and air-borne soldier who hit Normandy on D-day it was necessary for Ordnance to supply 1,500 pounds of equipment—from watchsprings to medium tanks, from M1 Garands to "Long Toms." Thereafter, it has meant more and more firepower and larger caliber weapons—up to the 8-inch gun and the 240-mm. howitzer—and the sustained supply of an average of thirty-five to fifty pounds of ordnance per week per man. In addition, U. S. ordnance is being used by our allies; British, Canadian, French, Belgian, Polish, Russian—even the Dutch Free Forces—have been equipped with some of our tanks, weapons, and vehicles.

Maintenance, of course, is the everlasting burden of Ordnance service, for every gun and truck issued to our customers, every pound of matériel put into service, becomes a part of the potential maintenance load. Today, Ordnance service is performing field maintenance in Germany beyond the Siegfried Line. As this is being written, some of our maintenance and supply companies have followed by a few hours the combat forces who have effected the initial penetration of the last Nazi frontier.

Back in the United Kingdom we are performing fifth-echelon maintenance at Ordnance base shops. In between, Ordnance maintenance crews are at work all along the line of communications, at the beaches and the ports of Northern France, by road patrols covering the highways across France and Belgium over which military traffic streams to the front, and at key installations en route. Everywhere the motto of Ordnance service is, "Keep it mobile; keep it serviceable; replace the item if you can't get it fixed in twenty-four hours."

For every soldier who hit the Normandy beaches on D-day Ordnance supplied 1,500 pounds of equipment including every part and component in the entire Ordnance catalogue of over 350,000 separate items. As the Germans were driven from France and into their Siegfried Line, Ordnancemen continued to supply and maintain our combat equipment and often fought side by side with troops of the line, using weapons they had but recently repaired.

FAIRLY considered, it is believed that the Ordnance problem in the present conflict has been unequaled in scope and complexity in the history of warfare. Two simple examples will illustrate this point. There are now hundreds of thousands of vehicles of all types operating with U. S. forces in the European theater of operations. Every vehicle in service means that a stock of parts—replacement motors, transmissions, axle assemblies, steering units, etc.—must be brought in and accessibly stored by Ordnance supply so that the vehicle can be kept in service by Ordnance maintenance. Further, in connection with vehicles, the consumption of tires has attained staggering proportions due to the rapid movement of our armies and the large dependence on motor transport for supply. For the 2½-ton 6x6 cargo truck alone, 100,000 replacement tires are required each month under recent conditions of operation.

As a second example, it may be conservatively stated that the U. S. forces have been adequately supplied with ammunition. For the first 100 days of operations on the Continent, the amount of ammunition of all types expended by ground forces has approached a total of 200,000 tons. Considered as individual rounds, this tonnage runs into the millions for various sizes and types. For instance, nearly 2,500,000 rounds have been supplied for the 105-mm. howitzer, of which the projectile alone weighs 33 pounds. In addition to making possible these vast expenditures by troops in combat, it is an Ordnance obligation to build up reserve stocks along the line of communications so that supply to units at the front will be steady, in the right quantities, and at the right places.

The Ordnance problem in the European Theater of Operations is being solved successfully, I believe, because Ordnance has organized two great fighting teams, over 3,000 miles apart—both carrying the same ball, using identical signals, and trained under one coaching staff and set of rules, though playing on different fields. The team directed by General Campbell has consistently carried the ball for us to the very goal line of the home field. For our part, we have tried to

General Sayler is Chief Ordnance Officer, European Theater of Operations.

place the ball in position for the scoring touchdowns being made daily by the armies under General Eisenhower here on the Continent of Europe. We know, too, that back of General Campbell and his highly efficient Ordnance organization stand our millions of supporters in American industry.

More than any one I know, Ernie Pyle has helped to get our perspective in this war down to the proper level, where victory is being won ever so slowly but surely by the collective, dogged, and skillful efforts of several million GI's. In this theater, Pyle took the time to see Ordnance in action on the GI level and came out with a fresh, clear understanding of what our boys in the greasy denims, who often are required to drop their tools for weapons and fight for their lives, are doing to keep Ordnance firepower in action against the enemy.

IT is not my intention to slight the meticulous planning, skillful coördination, and expert direction achieved by our Ordnance staff of the communications zone, supervised at headquarters by Cols. Joel G. Holmes, Earl S. Gruver, S. A. Daniel, and many other experienced Ordnance officers, by our Ordnance people on the base-section staffs together with personnel of the Ordnance base group headquarters, and Ordnance battalions and companies who are responsible for the work of more than 40,000 Ordnance combat-zone troops. The GI Ordnanceman could not live, work, or fight without their efficient staff work and direction.

The same should be said of Army Ordnance troops, also numbering in the tens of thousands, including every type of mobile Ordnance service organization, striving to keep the chain of supply unbroken in the field and to supress the maintenance deadline. Army Ordnance has kept faith with the front-line fighting man. In the campaign of rapid movement which we have just been through in France, Col. H. A. Nisely, who is Ordnance Officer on the staff of Lieut. Gen. Omar N. Bradley's Twelfth Army Group, tells me that Army Ordnance units have frequently had to change location twice a week; have learned to move, set up for service, and get operating again all on the same day.

Too much credit for Ordnance service in the First and Third U. S. Armies, which have so far carried the brunt of active operations, cannot be given to the achievements of our Army Ordnance officers and their staffs. Col. J. B. Medaris, with the First Army, and Col. Thomas H. Nixon, of Third Army, both of whom saw considerable field service in North Africa and Sicily, expertly analyzed each new problem of Ordnance service in the armies and found a solution in the face of ever-lengthening supply lines.

Between army and base-section Ordnance, there has been since D-day a highly versatile and mobile link in the chain of communications furnished by the Ordnance Section, ADSEC (Advanced Section Communications Zone) under the competent supervision of Col. B. S. Mesick who has pioneered for us after each new advance of the armies. Until D plus 70, Colonel Mesick and his people were responsible for all combat-zone Ordnance service on the Continent, having been supported by base sections in the United Kingdom. In August, after the armies broke through at St.-Lô and Avranches—beginning the swift pursuit of Nazi forces to Paris and the Seine, then on to the Moselle River in the east and through Belgium into Germany in the northeast—ADSEC likewise kept moving in a succession of quick jumps to maintain direct support for Army Ordnance, while base sections were successively organized in Normandy, Brittany, and Paris to fill the gaps in our line of communications from beaches and ports to the front.

In my mind, one of the most significant developments throughout this campaign has been the flexibility demonstrated by Ordnance service in the light of an ever-changing situation and set of requirements. It has resulted in a prodigious effort made by all our people, over 100,000 of them, to keep the factor of service time constant while the space factor changed drastically. Until about D plus 30, we were congested in a small section of Normandy, and one could not drive a mile without spotting an Ordnance unit. Our principal supply bases remained in Southern England from which the Channel crossing via LST or Liberty ship brought Ordnance supplies within range of beachhead facilities, thence almost direct to Army supply points.

During this phase of operations, congestion was the keynote, and the first four echelons of maintenance were operating almost side by side. Actual distances on the Continent were negligible, but bottlenecked traffic on the roads meant that all plans which involved the movement of replacement matériel forward, of equipment to be evacuated for repair, of individuals or units, had to be prudently based on speeds of 10 to 15 miles an hour. At one stage we were actually pressed to find suitable operating space for additional Ordnance units needed to meet the growing demands for supply and maintenance service.

In due course, these conditions changed drastically as the Third Army broke through to the south, then swung east to Paris, and the First Army, having spearheaded the advance, then pivoted the move and likewise pushed eastward together with other allied forces in the north. The fast-moving tactical situation kept Ordnance service constantly pushing forward; distances increased between supply and service points; and a vast network of service road patrols was organized. Very important was the fact that larger stocks of matériel—major items for replacement, spare parts for repairs, and, perhaps most critical of all, ammunition—had to be fed into the pipeline, that is, kept in transit so that deliveries of supplies needed at the front would be continuous and adequate. Naturally, this placed an increasing burden on motor transport throughout the communications zone.

AS the front advanced another one hundred miles from the beaches, it became necessary to have another day of supply in transit on the roads. No one had the time to think of consolidating, of trying to build up reserve stocks at key points along the axis of communications. Every one thought, planned, and strove to press Ordnance service ever forward so that there would be no interruption in satisfying the demands of our combat forces which remained continuous but kept always moving another day away.

The manner in which all the services performed during this critical phase of operations was, I believe, a tribute to the organization, training, and coördinated efforts of our troops in the combat zone. Ordnance service made good on its very large part of the over-all problem, made especially difficult because of the heavy expenditures of ammunition and because of the serious need to keep every vehicle and trailer in service so that no potential cargo-carrying capacity would be deadlined. So, while the factor of space over which Ordnance service had to stretch its operations enlarged daily, Ordnancemen worked to devise and improvise methods, to extend themselves to the limit of their capacities, in order that the time factor of Ordnance service might remain con-

Signal Corps

IN A BATTERED FRENCH TOWN AN ORDNANCE WELDER PREPARES TO JOIN A STEEL PLOW TO THE FRONT OF AN M4 76-MM. GUN TANK FOR USE IN UPROOTING LAND MINES

stant, that no piece of essential equipment would be out of the hands of a using unit for more than twenty-four hours, that no gun barrel would cool off for lack of ammunition.

THROUGHOUT the period just described, when our line of communications demonstrated an elasticity that reflected great credit on American determination and ingenuity, there was organized overnight, extended, and then extended some more, a transportation service that has become legendary in the ETO—the Red Ball Express—having top priority over the best available roads and given complete roadside Ordnance service all along the route, which came to extend hundreds of miles from the beaches. Thousands of vehicles rolled daily over Red Ball routes from which all other traffic was excluded—many of them vehicles which had been assembled from the twin-unit pack at our field assembly plants, all of them maintained by Ordnance service stations along the routes.

Ordnance patrols are constantly on the roads, spotting stalled vehicles, giving service to drivers, procuring wrecker service when needed. Under this service, if a vehicle is to be deadlined for more than five hours, Ordnance will supply a replacement so that the cargo of ammunition, food, gasoline, or other supplies can be dispatched to the front.

One of the most heartening sights during the past one hundred days has been the long lines of Nazi prisoners being transported to the rear—testimony to the successes of our combat troops—and the enormous quantities of destroyed Nazi equipment—visible evidence of our superior firepower. The amazement shown by civilians in liberated countries while they stand gaping at the endless quantities of ordnance moving up for the destruction of the enemy is equaled only by the expressed confidence of our own fighting men in the quality of their combat tools. Our Ordnance Technical Intelligence people have scoured the front and examined every important Nazi installation or depot for ordnance as it fell into our hands, and they have also talked with many prisoners. The conclusion time and time again is that, by and large, U. S. ordnance, item for item, is equal or superior.

Under the pressure of present events and with all our thoughts harnessed to look forward at impending problems, it is easy to forget the two years of painstaking preparations which we went through back in the United Kingdom. There was the progressive planning in infinite detail of requirements and organization, which went so far in some cases as to simulate actual installations on the Continent which we expected to occupy. There was the advanced operational training of Ordnance units arriving from the United States and the growth of base depots and base shops to a point where every type of Ordnance work could be performed.

GRADUALLY, the facilities were completed, the organization crystallized, and Ordnance made ready for the "jumping-off" day, soon to come. Then came the rush to complete a vast waterproofing job, in order that every vehicle and piece of ordnance would land on the beaches successfully and ready for instant action. Finally, there was the intensive schedule of super service which Ordnance had to give in the marshaling areas of invasion ports in England making last-minute inspections, repairs, and replacements. After which, beginning on D-day, Ordnance service moved onto the beaches and has continued to follow through ever since.

Field Service in the First Army

Ordnance Maintenance Meets the Test of Velocity Warfare

Col. J. B. Medaris

More than 15,000 Ordnancemen are now with the First Army in the European theater in units scattered over an area from 75 to 150 miles in width to 300 miles in depth. They are handling more than 2,500 tons of supplies a day with their own vehicles and meeting with amazing ingenuity the demands for mobile Ordnance service.

WHEN I first came into Ordnance from the Infantry, about eighteen years ago, the Ordnance officer to whom I reported told me: "There is no 'i' in Ordnance." Today, I tell my officers and men that we have only one excuse for living—one reason for being here—and that is to serve the men who fight. We must serve them with weapons, with vehicles, and with ammunition. We must give them the supplies and equipment they need for combat, and we must keep that equipment in the best possible condition. That is the mission of Ordnance Field Service in the First U. S. Army. It was our mission in the days of preparation before D-day; it has remained our sole objective throughout the campaign of the past months which now brings our Army to fight on German soil.

Before D-day, First Army Ordnance had the job of equipping the army's troops, training its Ordnance units, and making detailed Ordnance plans for the invasion. To do this it was, of course, necessary to get the Ordnance equipment and supplies that were needed, but, equally important, we had to create in all Ordnance personnel the proper mental attitude toward their job. We in Ordnance must take pride in the job we can do for the fighting man. Every one who works in Ordnance should retain his independence of thought and action. He must be ready to act quickly and intelligently with a freedom that allows him to accept responsibility and make independent decisions. If the job cannot be done by the book, throw the book away—the job is the thing.

There are two separate jobs of Ordnance Field Service. One is the supply of ammunition. Another is the supply and maintenance of fighting vehicles, weapons, motor transport, and other Ordnance equipment. The supply of ammunition I consider, above all, a tactical problem rather than a problem of supply. The consumption of ammunition is so varied, depending upon the tactical situation, that all established SOP's and manuals on the subject furnish little help. They do not fit the highly specialized, mobile type of warfare that has characterized the campaign in Europe.

Since the breakout at St.-Lô, our problem has been to outguess both our own and the enemy's tactical commands to get the right amount and type of ammunition at the right time and place when it will be needed. From G-3 we learn the character of the attack plan, and from G-2 we find out what type of opposition may be expected. From this information it is up to Ordnance to decide what matériel losses to expect, what ammunition or special weapons may be required to smash specific obstacles, and then to translate the results of all available information into requirements which we must be prepared to fill.

Months before D-day, Ordnance technicians were busy at work in depots throughout the United Kingdom. Uncounted man-hours were expended to get each piece of equipment ready for the invasion date. Many modifications were necessary in all types of ordnance. Waterproofing of vehicles and tanks was carried out under the watchful eyes of trained Ordnance specialists. The latest developments from laboratories and proving grounds everywhere, as well as from battlefield experience, had to be incorporated into equipment already in the United Kingdom or on its way to us across the ocean. Additional armor plate was welded to many combat vehicles. New types of specialized equipment were tried out and approved or discarded. Lastly, full-dress rehearsals of landing operations were carried out in special training areas along the coastline of the British Isles, in all of which Ordnance Field Service participated fully.

First Army Ordnance made ready for every D-day contingency. In the initial landings, matériel losses had been anticipated, and, where possible, provisions for resupply had been made. There were exceptions to this. Heavy seas on one beach swamped a number of DUKW's that were off-loading 105-mm. howitzers. The howitzers for an entire battalion were lost, but a rush order to the communications zone brought a replacement shipment, received within seventy-two hours from the time the loss was first reported. There were also heavy losses in mortars, light machine guns, and Browning automatic rifles, due principally to the airborne operations. Reserves of these items were supplied by air transport from the United Kingdom in time to prevent a critical shortage.

BETWEEN D-day and D plus four the First Army Ordnance units were landed, coming ashore with as many replacement guns and vehicles as they could carry. Large numbers of vehicles, loaded with spare parts and other urgent supplies, were brought in by Ordnance units as part of their extra organizational equipment. This helped to relieve shortages that developed soon after D-day when a 4-day storm stopped all landing of supplies across the beaches. Ammunition was a critical item at this time. To make up for the 4-day delay in landing supplies, over 1,500 tons of ammunition were flown in from the United Kingdom in 3 days. This partially relieved the situation, but shortages in some types still existed, and a rationing system was put into effect that continued on certain types until after D plus fifty.

The fall of Cherbourg and resulting gain of additional territory added to the Ordnance supply problem. Rapid increase of troops thinned out the supplies on hand in Normandy. Evacuation of battle losses became more of a problem. About D plus twenty the hedgerow problem developed. Ammunition expenditures ran high. Tank and small-arms losses were heavy. It was here that Ordnance Field Service performed a miracle of mass production. A device was re-

Colonel Medaris is Ordnance Officer of the American First Army.

quired to break the hedgerow stalemate. It was developed by an ingenious American officer as a simple modification on the tank which enabled our armor to go through the hedgerows without being stopped by Nazi fire. To do one modification was easy; to modify the tanks of several armored divisions in a given time was not. Materials were required, so Ordnancemen combed the beaches for the steel Nazi landing obstacles known as tetrahedrons. They organized a special crew of welders and skilled mechanics, and almost 300 units were made up in 48 hours by Ordnancemen to complete the job in time for the break-through that started the destruction of the German Seventh Army.

TRAIN your men as you would a basketball team, not a football team. You cannot call a set play that has been decided in the preliminary huddle and practiced many times; the men must react as a team to the unexpected tactics of the opponent. Our men must know who has the ball and that when they pass it over their shoulder there will be a teammate to catch it.

IN planning operations for Ordnance Field Service, I have found that there are only two guiding principles that need be followed. All other attempts at detailed planning and timetables are a waste of time and effort. First, determine and obtain the bulk resources, the man power, the tools, materials, and equipment, and get them to the area of the operation—not, please note, to a specific predetermined point. It is seldom, if ever, that you can say you will be at a certain spot on a certain day with certain equipment. There are too many variables for that. For example, there are the enemy's operations which you do not fully know until after they have taken place. Secondly, maintain at all times the power of flexibility. This is probably the most important principle of Ordnance Field Service that I can mention. Flexibility in modern warfare is an absolute "must" for Ordnance Field Service if the combat forces are not to bog down hopelessly for lack of proper tools to do their job.

Train your men as you would a basketball team, not a football team. You cannot call a set play that has been decided in the preliminary huddle and practiced many times; the men must react as a team to the unexpected tactics of the opponent. Our men must know who has the ball and that when they pass it over their shoulder there will be a teammate to catch it.

It is a good policy, and one which I have followed in this campaign, to keep Ordnance troops in tents during the summer weather. There is less tendency to "take roots," a less permanent feeling about the installation. Ordnance units of an army that has moved as rapidly as the First Army through France and Belgium must be ready to move on a moment's notice and to complete the move in a matter of hours. Too-comfortable quarters in buildings tend to act as an anchor to a unit ordered to move in a hurry to support a swift advance.

During the early days in Normandy, when progress was slow due to the nature of the hedgerow battle, I found many Ordnance units getting into a rut. They were settling down with a feeling of permanence. To prepare them for the break-through which we hoped would open the door to rapid advances across France, I frequently issued almost impossible directions without warning, resulting in a scrambled confusion as units made moves that seemed without reason. But they were jarred back into the reality of modern mobile warfare, and when the actual break-through came shortly afterward, they had fully regained their flexibility of thought and action.

From that point on, many Ordnance units got their first taste of the flexible warfare that for sheer speed of advance surpassed the Nazi *Blitzkrieg* in the early phases of the war. The experience of maintaining contact with fast-moving front-line troops was new to many of the units, but they met the test with success and quickly adapted themselves to the demands for mobile service.

At one time during the advance through Northern France and Belgium, the front and rear Ordnance units were 375 miles apart. The only link that held them together was an Ordnance radio network that had been established for communication between our own units. Radio equipment is not listed on the Ordnance tables of equipment, but had not the preinvasion planning anticipated such a need, the fast pace of battle might have seriously affected Ordnance operations and delayed the advance of the combat forces.

At this period, supply of ammunition in the army area was also stretched out for as much as 150 miles. The ammunition supply points were kept on wheels —trucks and trailers were left loaded in the points ready to move on to more advanced points. When the load was removed for combat use, each truck returned for another supply. Leaving the ammunition on wheels saved valuable time and labor and made it possible for these supplies to keep up with the fighting forces. This method is not in the training manuals or books—but this is war! Expediency counts! If it works, use it; if it doesn't, try something else!

There are now more than 15,000 troops giving Ordnance service in the First Army, and they are in units scattered throughout an area that varies from 75 to 150 miles in width and up to 300 miles in depth.

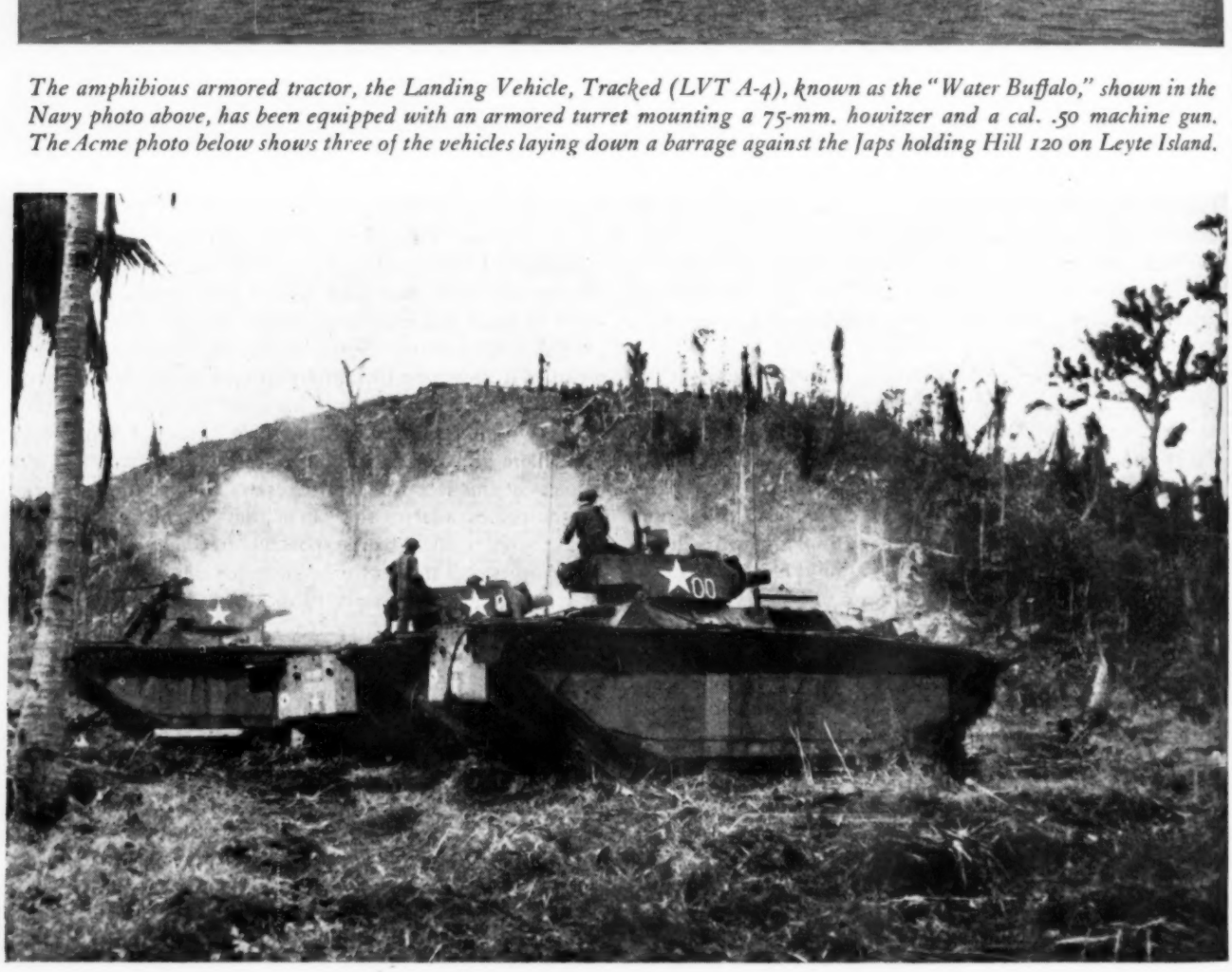
TO serve the First Army, Ordnance troops are required actually to handle and pass on more than 2,500 tons of supplies a day with their own wheels and tracks. There is no time to teach our men from books. We give them the tools and the job, and we expect results. It is amazing what ingenuity is shown by the American soldier-technician when it comes to keeping the tools of his army in fighting condition.

As Ordnance Officer of the First Army, I have found that there are four important requirements that help insure success at this job: (1) It is necessary to have the confidence of the commander to the extent that he will give the Ordnance Officer the greatest possible freedom of action. (2) All officers and men must be indoctrinated with the flexible state of mind so necessary to meet the constantly changing situations of modern warfare. (3) There must be the resources of man power, tools, and equipment to meet all emergencies. Never base a plan of action on the theory that you will have enough. Base it on a probable scarcity and be ready to manufacture the supplies not on hand. (4) A spirit of confidence, trust, and acquaintance must be developed throughout the divisions and corps so that a man's word becomes his bond. Mutual trust and the acceptance of responsibility are essential to get the job done quickly and efficiently.

But our principal objective in the days of preparation for the D-day assault and during the campaign through France and into Germany has been "to serve the men who fight."

New Firepower for the "Water Buffalo"

The amphibious armored tractor, the Landing Vehicle, Tracked (LVT A-4), known as the "Water Buffalo," shown in the Navy photo above, has been equipped with an armored turret mounting a 75-mm. howitzer and a cal. .50 machine gun. The Acme photo below shows three of the vehicles laying down a barrage against the Japs holding Hill 120 on Leyte Island.



Old Weapons and New

America's Armament in the Past, Present, and Future

Maj. Gen. C. T. Harris, Jr.

THE Army Ordnance Association was founded in 1919, just after World War I, by a small group of men who were determined that the lessons of that conflict should not be forgotten and that we should not again be found unprepared industrially to the terrible degree that we were in 1917. The Army Ordnance Association is an organization that any one can admire. It has no selfish motives, it does not interfere in national politics nor in War Department politics. It has as its prime objective industrial preparedness. The record of industry in World War II is a fitting testimonial to the success of the work of the Association during these last twenty-five years.

In the early 'thirties, when military activities were at a low ebb, when the average man in the street had been led to believe that there would never be another war, when munitions manufacturers and those interested in industrial preparedness were branded as "war mongers"—all through that dark period, the Army Ordnance Association kept its eye on its primary objective of keeping alive in this country an interest in industrial preparedness. It helped the Ordnance Department in contacts with industry and helped interest industrial leaders in Ordnance Department problems, so that when war did come industry would know the task it had to perform and would have given some thought to the way it would be done.

In my opinion—and I feel that I have been in a position to observe critically—American industrial production in this war has been superb. In face, without the industrial production of America, the allied cause would have been lost on every fighting front. In industry's great achievement, the Army Ordnance Association has had a leading rôle and can feel a great sense of satisfaction in the help it has given to the security of this country.

IN discussing America's old weapons and new, I am tempted to go back many, many years. Forty years ago, I was a cadet at the United States Military Academy at West Point. In my four years there, I knew and associated with most of the leaders of the American armies in this war. General MacArthur graduated from the Academy the day before I entered. I saw his graduation parade. Today, General MacArthur is leading our victorious armies in retaking the Philippines—an achievement dear to his heart. In the senior class at the Academy when I entered was General Stilwell, another 4-star general, who has commanded the American forces in the Chinese sector. General Stilwell is a very colorful and successful soldier and is very close to his men.

In another class ahead of me at the Academy there were two very distinguished men. General Wainwright, who is now a prisoner of the Japs, was my cadet captain—I was his first sergeant, and he was my close friend. We all view with concern the long confinement of "Skinny" Wainwright as a prisoner of the inhuman and despicable Japanese, and we all unite in hoping that he will return from that captivity in good health and be enabled to help put the Japs where they belong.

Our present ordnance is superior to that of our enemy, but it would be fatal if we remained satisfied with what we have. We must make absolutely sure that continuing research and development will keep it always ahead. Only in that way can we be certain that the peace which we are striving for will be a lasting one.

Another member of that class was a fellow citizen of yours who is here tonight—George Morrow, the president of the Birmingham Post of the Association. He was captain of "B" Company, as I remember, and I worked for him as a cadet when he was manager of the football team and I was assistant manager. George Morrow and his company have done yeoman service in turning out ordnance for our armies in this war.

IN my own class, we had another 4-star general—General Arnold, Chief of the Air Corps. He is a fine soldier and a fine leader of men. Another classmate of mine is a very distinguished member of your Birmingham Bar, my old friend and ex-roommate "Sunny Jim" Martin, now known by the much more dignified title of "William Logan Martin." Also in the Corps with me was General Patton—"Georgie" Patton—whose spectacular career is familiar to you all, and many other distinguished soldiers.

When George Morrow, Sunny Jim Martin, and I were cadets at the Academy, the arms we had consisted of the Krag-Jorgenson shoulder rifle and the old 3.2-inch field gun, as well as seacoast weapons of varying sizes and kinds. In the fall of 1903 we were issued the new Springfield caliber .30 shoulder rifle, which was standard in our Army from that time up to 1939. This rifle was the finest shoulder arm in the world; it was accurate, dependable, and effective. But later, the need for more firepower became apparent, and, as a result, the semiautomatic rifle, known as the Garand, was developed and finally, after many trials and much tribulation, adopted.

The adoption of a small-arms weapon in the Army is always accompanied by controversy, strife, and bitter conflict, and the Garand was no exception. I was involved in this activity, and I recall that at the height of the controversy, knowing that I had to stick my neck out on one side or the other, I went down to the Eastern Shore of Maryland with a friend of mine and personally fired some 3,000 rounds in the Garand rifle. I got to know the gun—its strength, its weaknesses, and its effectiveness. I, among many others, came out wholeheartedly in favor of the Garand and did what I could to assure confidence in it and in its successful manufacture. At that time we were making some twenty Garands a day at Springfield Armory. By slow and painful degrees and by efficient management and bulldog determination, this production was brought up step by step until it had exceeded

General Harris is the Commanding General of Aberdeen Proving Ground, Md. This is an address delivered before the Birmingham Post of the Army Ordnance Association, Birmingham, Ala.

4,000 rifles a day at this one establishment. The record of the Garand rifle in subsequent years speaks for itself.

The war we are fighting today is so different in character from the last World War that we have had to learn many new tactics and new methods. Not only have we had to develop new ways of fighting, but we have also had to develop new weapons with which to fight. World War I was a stable and relatively simple war compared with this one. The action took place primarily on one continent. Armies marched across a country, dug themselves into long lines of trenches, and spent month after month lobbing shells at each other.

Two major developments of the last war were the trench mortar, which enabled us to shell the enemy troops in their trenches, and the tank, which helped our infantry make their way through machine-gun fire and barbed wire.

THE war we are now fighting has presented problems that the soldiers of the last war never had to face. This war is primarily a war of mobility. Only at Stalingrad have extensive trenches been used; otherwise our lines have not stood still for long periods of time. To establish them we have had to charge across beachheads and smash through carefully prepared enemy fortifications. Once the beachheads were established, we have had to pursue the enemy inland at breakneck pace over all kinds of terrain.

We are fighting this war all over the globe. It knows no bounds from the extreme cold and snow of the Arctic to the equally extreme heat and humidity of the tropical jungles. So we have had to develop new weapons to meet the new conditions. In the last war, the tank was nothing but a rolling fortification. In this war, it has become a deadly weapon in its own right, with great firepower and mobility, used as a powerful assault weapon to smash through the heaviest enemy defenses. The firepower, accuracy, and range of our artillery have been vastly increased. Devastating barrages so intense that not a living thing can survive are placed only a few yards ahead of our advancing troops, and enemy installations many miles beyond the fighting front are smashed by our heavy long-range weapons.

In the last war, the primitive aircraft we had were used mainly for reconnaissance. The bombs they dropped were, by comparison, ineffective improvisations. I don't have to tell you anything about what our aircraft and bombs are doing in this war. In the last war, our antiaircraft weapons consisted primarily of machine guns and some light artillery. In this war, antiaircraft artillery has become a science in its own right and consists of powerful, long-range weapons which can be used against land or air targets and operated with fire-control instruments which are marvels of scientific achievement.

In order to overcome the obstacles in the path of our troops, we have had to develop new weapons that were altogether unheard of in the last war. To smash through the prepared fortifications of the enemy, we have had to develop special projectiles which can penetrate through many feet of concrete. To stop the advances of enemy tanks, we have had to develop antitank mines and antitank guns. To help us storm the beachheads, we have developed rockets which can be fired ashore by the thousands to clear the way for our troops. In order to make our invasions successful, we have had to learn not only to drop troops by parachute but also to transport by air and drop heavy artillery, ammunition, and other weapons to keep them fighting.

Then there has been the continual effort to match and outmatch the weapons of the enemy. When the enemy develops a new weapon, we must first of all develop a weapon to neutralize it. If it has any new principles, we must seize upon them and improve them. There also is always the ceaseless demand from the field for longer range for our artillery and higher velocities for our shells. Naturally, the greater punch we put into our artillery, the greater the firepower, the quicker is victory, and the fewer those who unfortunately must pay the supreme sacrifice.

Let us consider briefly some of the high lights of ordnance development in this war. Perhaps the most significant development—certainly the best publicized—is our bazooka. This completely revolutionary weapon is a great Ordnance achievement. When it was first used against tanks in North Africa, the enemy tank commander ordered a hasty retreat. When captured later and asked why he ran away, he stated he thought he was being attacked by 155-mm. guns. This weapon, which gives each infantryman the striking power of a heavy-artillery piece, helped win for us the North African campaign. The bazooka is the best known of our rocket developments, but it certainly is not the most spectacular. Unfortunately, security considerations prevent me from telling you about some of our latest rocket developments which would indeed amaze you. Rockets in this war, like the tank in the last, are in their infancy. The potentialities of the rocket as a future weapon must be left to the imagination.

THE rocket is only one example of the progress we have made. There is that basic weapon of infantry firepower which I referred to before, the M1 Garand rifle. At the end of the last war, our General Staff charged the Ordnance Department with the job of developing a shoulder weapon that could be fired repeatedly by a simple pull of the trigger without any reloading or manipulation of the bolt. The proposed rifle, which was to have all the workings of a machine gun, was to weigh no more than the old shoulder rifle and be readily adaptable to rapid mass production. It took the genius of a veteran Ordnance engineer, John C. Garand, and almost twenty years of effort by a large number of the Ordnance Department personnel to bring the development of this rifle to the point where it could meet the rigid Infantry field-service tests and also be fully adaptable to mass production.

Even after acceptance by the Infantry, many rifle enthusiasts continued to criticize the Garand. Final judgment on the rifle came soon after Pearl Harbor when General MacArthur cabled from Corregidor that "the M1 rifle is performing magnificently in the mud and jungle foxholes of Bataan." The American Army is the only one that equips each of its combat soldiers with a semiautomatic rifle. It is this tremendous superiority of firepower that has enabled our Infantry to push steadily forward on every front.

Another basic weapon carefully developed by Ordnance during the two decades of peace is the justly famous 105-mm. howitzer. This weapon throws a 33-pound high-explosive projectile against enemy troop concentrations with such rapidity and accuracy as literally to drive enemy troops mad. It is simple and rugged and highly mobile. An outstanding feature of this powerful fieldpiece is the rapidity with which it can be fired by a skilled crew. After the end of the Battle of Africa, German prisoners asked to be shown the "American large-caliber automatic cannon."

A larger cannon, the equally famous 155-mm. gun, affectionately called "Long Tom" by our troops, accurately fires

a 95-pound high-explosive projectile a distance of over fourteen miles! This gun also took many years to perfect. Other larger and more powerful guns are also now in effective use.

In the last war, the 75-mm. gun was one of our principal artillery pieces. We had to use horses to drag it across the battlefields of France, and we had to haul it into firing position by man power alone. It was the artillery weapon that drove the Germans back in final retreat. In this war we have taken that same 75-mm. gun and mounted it in a medium bomber. The pilot has only to press a button to fire powerful artillery shells into enemy supply dumps and ships and emplacements. You have already seen action photographs of the Mitchell bombers which carry this weapon, and you have read accounts of the havoc they have wrought.

In antiaircraft artillery, we have developed the 120-mm. antiaircraft gun, popularly and justly called the "stratosphere cannon." This weapon can fire its shell 60,000 feet into the air—a distance much higher than any plane can fly.

People smile when they see the model of the first American tank exhibited at the Smithsonian Institution in Washington. They smile because they are comparing that clumsy, awkward-looking Rube Goldberg device that crawled a few miles an hour over the French battlefields in the last war with the powerful, streamlined heavy tanks of today that carry artillery weapons of tremendous striking power. But, between the first tank and our present ones, lie thirty years of continuous effort. Here I should like to mention a feature built into our tanks which is sometimes forgotten; namely, mechanical reliability. Without this outstanding feature, which is one of the factors that makes our tanks superior to those of the enemy, our armored forces in Europe would not enjoy the mobility they have today.

THIS is a war requiring extensive amphibious operations. Landing on a hostile shore has always been regarded as one of the most hazardous and most difficult of military operations. Never before have so many such landings been required, and one of the great achievements has been the provision of suitable equipment for this purpose. For security reasons, I am unable to mention some of the most dramatic developments in this field, but I can point to the "Duck" as a classical example of a vehicle for ship-to-shore operations.

It has been truly said it takes a generation to develop a new weapon. Many of the weapons first developed in the last war were not perfected until this one broke out. Unfortunately, the development time was often made longer than it should have been by the lack of sufficient funds. During the lean years of peace, the appropriation for the operation of the entire Ordnance Department was sometimes as low as seven million dollars a year. With this amount of money we could hardly afford to build one tank a year—along with the hundreds of other weapons for which we were responsible. Often our designs and developments never left the blueprint stage, and most of our planning was only paper planning. When we had maneuvers that called for tanks, we had to use automobiles and label them with a sign that said "Tank" because we couldn't afford to build the tanks we needed.

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But, even when our development has been miraculously swift, as indeed it has during the past few years, it could not have been accomplished without the active and patriotic coöperation of science and industry. In the development of new weapons, we have had to ask the assistance of the scientist and the research worker many times, as well as the full help of industry.

With the aid of the scientist we have brought our weapons to the production stage. This is the point at which industry takes over. Industry has helped us in countless ways to make our production the miracle it has been. It has taught us short cuts in manufacturing. It has taught us the use of substitutes when the needed materials were not available, and it has turned out so steady and copious a stream of weapons that our troops have never been held back for lack of supplies.

MANY of our most successful weapons in this war are still in their infancy, and much work remains to be done. Our rockets are astonishing and terrifying the enemy, but what they will be in the future must be left to the imagination. There will be no ocean barriers—time and distance as we know them will be abolished. The magnificent performance of our artillery has been one of the deciding factors in the European campaign, but its efficiency can be improved still further. Our automotive equipment has been performing miracles both in combat and in solving the logistic problem, but engines, transmissions, fuels, and lubricants are items for further development. Our fire-control equipment consists of some of the most complex instruments known to man, and their performance is now almost uncanny. But there is no end of the possibilities in which electronics, television, and similar items of modern science will not find application.

Our present ordnance is superior to that of our enemy, but it would be fatal if we remained satisfied with what we have. We must make absolutely sure that continuing development and research will keep it always ahead. Only in that way can we be certain that the peace which we are striving for will be a lasting one.

In the success of the industrial side of this war, many people should receive credit: The War Department for knowing what it wanted and where it could get it, and industry for being able to produce the weapons of the quality and in the quantity needed not only for ourselves but for our allies.

It has been my privilege throughout much of my Ordnance career to be closely associated with industry. Before the war I and many others worked with industry in the preparation of plans for ordnance production, and in the last four years we have watched industry initiate and develop its production in conformity with those plans. I feel confident in saying that the real secret weapon of this war has been American industry's ability to produce!

From Poland to Pearl Harbor

A Review of the Arms and Policies of World War II

Maj. Hoffman Nickerson

Today when so many are absorbed in their own tiny fractions of the gigantic war effort, it is worth while to try to see that effort as a whole. In order to view events in perspective, it is necessary to summarize from time to time what has happened and estimate as closely as possible the main lessons. This Major Nickerson does with compelling clarity in the present article.

THAT arms are the servants of policy, so that complaints of "political interference with strategy" are really complaints against the particular policy which the armed men are being used to serve, has been familiar ever since Clausewitz. As soon as we consider the policies underlying the present war we see the startling new fact of internal division. Almost everywhere men differ irreconcilably over the fundamental idea of ownership. Since this, and the related question of how far peacetime governments should control the persons and purses of the governed, are matters of general morals irrespective of place, almost all governments find their policies deflected by it.

Of course the nature and extent of the deflection differ with each country, but in most provinces of Christendom many men are tempted to prefer certain sorts of foreigner to other masses of their fellow citizens. If any one doubts this, we need only utter the words "Fifth Column." Since the horrible religious wars of the sixteenth and seventeenth centuries, differences of doctrine have bred no such bitter internal quarrels.

Further, the universal difference between the world-wide groups crudely called "left" and "right," together with the increase in governmental powers which is, on the whole, identified with the antitraditional or "leftward" tendency, has by no means softened the local quarrels between nations. On the contrary, these last are more bitter than ever. A capital instance is the Russo-German quarrel. By the standards of 1914, the U.S.S.R. is the "leftward" state par excellence, while the National Socialist government of Germany, although not so far to the "left" as the Bolsheviks, has nevertheless gone a long way in that direction. In spite of the common "leftward" tendency of the two governments, the hostility between the two peoples certainly seems much greater than thirty years ago. Indeed, we might argue that in 1914 most Russians did not dislike Germans at all.

Turning from policy to arms, the divided and mutually hostile peoples possess more science—knowledge of the properties of physical objects—and greater aggregate wealth than ever before. Hence they can feed themselves even after devoting a very large part of their labor power to fighting and military industry. Also their military instruments are novel, complex, and powerful. To take a single striking instance of material change, the hand-operated magazine rifle, although invented within a single long lifetime of today, begins to seem a somewhat primitive weapon.

IN specific policy, the immediate occasion for the present war was the guarantee given by the English and French Governments to Poland in the spring of 1939 and the subsequent invasion of Poland by the Germans. Berlin had prepared for this move by an understanding with Moscow, including an arrangement for the partition of Poland when that country should have been conquered by German armies.

The Germans planned to begin by throwing from 50 to 70 divisions—at least four-fifths of their ground strength—and well over 2,000 planes—more than two-thirds of their air strength—upon Poland, meanwhile standing on the defensive with the remainder in the West between Switzerland and Luxembourg. On the same frontier, the Anglo-French also planned to hold the Franco-German frontier defensively, meanwhile blockading Germany by sea and gradually building up their own land forces.

THE reasoning underlying the Anglo-French plan seems to have been based upon an overestimate of the extent to which sea power could injure Germany by blockade. There was certainly an overestimate of the strength of the defense which could be made against possible German offensives. On the other hand, we must admit that the political geography of 1939 in the West favored the use of sea power, inasmuch as Germany was boxed into the North Sea by allied territory and by neutrals whose overseas imports could be strictly rationed as they had been toward the end of the last war.

Thus the present war began as a duel between land and sea power under conditions favorable to the latter. The strategic question was how far the Anglo-French could use their sea power to strengthen their relative position by land and, conversely, how far Germany could use her land power to improve her position at sea. Axiomatically, superior sea power must shoulder a heavy defensive burden, since it must protect its own sea-borne traffic against harassing attacks, while the weaker sea power can concentrate on that form of attack since it has no high-seas traffic of its own which must be covered. For the moment, however, circumstances lightened this burden. The effect of air work upon both land and sea operations was yet to be tested.

The German invasion of Poland introduced a startling novelty: lightning war. The Poles, isolated from their allies and weaker than the Germans in everything except personal courage, could have been saved only by a strong French diversion, which was not forthcoming. It was the speed of the German victory which was astonishing. In only eight days the Germans, pushing a tank force to the outskirts of Warsaw, had compromised the Polish field armies. In less than three weeks practically all those considerable field armies had been militarily destroyed.

Poland was only the beginning of a crescendo of German lightning victories culminating in the fall of France. The reasons for these were in part political and in part technically

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military. On the political side, the Germans moved into Poland, Denmark, Norway, Holland, and Belgium without declaring war. In most cases the verbal German defense for these acts was like that of the rapist who protested that, had he not done so, some one else would eventually have deflowered his youthful victim. Every internal weakness of Germany's opponents and victims was exploited, often by methods which traditional morals would have called treacherous. Technically, the enormous effect of air superiority in support of surface ships and ground troops was clearly shown. On land, when air superiority was combined with tank superiority, the German power to exploit success seemed fantastically great. Armies of the 1918 model, without strong air and tank forces and without abundant antiaircraft and antitank guns, were helpless.

By June 1940, the Germans, at trifling cost to themselves, had mastered all Atlantic Europe from the Spanish border to the North Cape. They had been joined by Italy, and the only great power still in arms against them was England.

German land power had radically improved the position of German sea power. Although German high-seas trade remained almost nonexistent and German surface warships seldom ventured out of coastal waters, nevertheless German planes, and especially submarines, could now seriously interfere with English shipping.

It has since been argued that the Germans should have invaded England promptly after the fall of France. Although the English were still greatly superior in all types of surface warships, nevertheless surface ships in narrow waters are vulnerable to air attack, and the *Luftwaffe* outnumbered the R.A.F. three to one. In ground forces, the English were weak, especially in point of equipment. Consequently, so it is often said, the Germans should have lost no time in throwing troops both by air and by sea into the Island, accepting the inevitable losses but confident that the mere numbers of their planes could at the same time have worn down the R.A.F. and dealt with the British Navy which would have been attacking their troop-carrying barges and other German shipping. Certainly if any considerable part of the German Army could have been landed and supplied, the German veterans must have beaten down the most determined and politically united English resistance because that resistance would have been so ill-armed.

THE failure of the Germans to invade promptly can hardly have been due either to a characteristic love of elaborate planning or to ignorance of the British weakness in ground troops. They probably knew the English military position fairly well, and the extreme boldness of a number of their decisions makes it probable that they would have invaded promptly, planning or no planning, had they thought that, in general, time was working against them, as in the particular matter of English ground forces it certainly was.

Instead of invading promptly under air cover, they launched an air attack, meanwhile collecting barges suitable for shipping troops across narrow waters but making no concerted and determined effort to use them. Since the check which they were about to suffer was so capitally important, their probable reasons for so acting are of high interest. Evidently they greatly respected the R.A.F. A single incident, Dunkerque, had marred the completeness of the series of German victories. When the British Expeditionary Force, together with a considerable body of French troops, had retreated to that point, a large proportion of the trapped men with their light equipment had been successfully shipped to England. One circumstance contributing to this astonishing result had been that numerous canals make the Dunkerque region an antitank fortress.

Another extremely significant factor, however, had been an abrupt local shift in air superiority. Dunkerque is about a hundred miles from the German border, and the retreating Belgians had effectively blocked their own airfields while English fighter planes could now operate from home bases nearby. Moreover, the quality of British planes and pilots, now for the first time used in force, proved excellent. Since their mass of barges and their embarkation drills on the French coast to the Channel can hardly have been intended as mere threats, the Germans must have meant to invade. But evidently they did not mean to do so until the R.A.F. had been disposed of.

IN specific policy, the immediate occasion for the present war was the guarantee given by the English and French Governments to Poland in the spring of 1939 and the subsequent invasion of Poland by the Germans. Berlin had prepared for this move by an understanding with Moscow, including an arrangement for the partition of Poland when that country should have been conquered by German armies.

A DISTINGUISHED English writer on war, Adm. Sir Herbert Richmond, has likened the strategic importance of the R.A.F. Fighter Command in 1940 to that of the British battle fleet off Brest in the old wars against France. Since that fleet could bring to battle any French heavy ships venturing into the Channel, the French troop-carrying barges of that time could have been covered only by a flotilla of light naval craft which the more heavily gunned British flotilla could defeat. Consequently, the French never tried to invade. Had they ever been able to deal with the British Brest fleet, the story would have been different. Similarly, the Germans of 1940 evidently felt that they must first deal with the R.A.F. Fighter Command. While the Royal Navy and the English coast still possessed air cover, the game did not seem worth the candle. Incidentally, one German embarkation drill on the French coast was roughly handled by R.A.F. bombers.

The German air attack on England was not an all-out, neck-or-nothing affair. On the contrary, the conduct of it suggests a tentative operation hesitantly permitted by the High Command on the understanding that losses must be kept below a certain figure. No other guess fits the repeated changes of objective and method.

The first stage of attacking coastal convoys, ports, and coastal airfields was a logical preliminary which had a measure of success. On the other hand, the cost was high: nearly 700 German planes to about 150 British. The second phase of attacking inland airfields and aircraft production centers was equally logical but almost as costly: more than 550 German machines to less than half as many British.

Here, however, German logic wavered, for the third round was one of concentrated attack on London, indicating that hope of knocking out the R.A.F. was fading. Instead of an intelligible prelude to invasion, this seems a flopover into the Douhet theory of seeking victory by inflicting civilian distress. Be that as it may, the losses in this third phase went still more heavily against the assailants who lost nearly 900 planes. The German air effort now diminished into a feeble

Douhetism of a sort intended to cut air losses; *i. e.,* night attack on London by fast planes originally designed as fighters and capable only of small bomb loads.

After making all possible allowance for the superior firepower and general technical excellence of British fighters compared with the German bombers of that day, still the German admission of defeat in the air over England tells heavily in favor of Clausewitz's familiar axiom that defense is the stronger form of war. Douhet, it will be remembered, had claimed that in the air attack must be stronger than defense. Whether this particular attack might have succeeded had the defense been politically distracted we shall never know, for no pro-German fifth column helped to spread panic in bombed British towns.

AT the beginning of 1941 the Germans, although disappointed of immediate victory over Britain, still had excellent prospects. They had little reason to fear a British counterstroke, for most of the man power of the Island was directly or indirectly engaged in supporting the British air effort, in maintaining British surface superiority at sea, and in combating starvation from the counterblockade carried on by German planes and submarines attacking merchant shipping. The Italians had accomplished nothing in the Mediterranean, and British armies, following traditional British strategy, had gained certain minor successes in overseas theaters. They had cleared the Italians from Abyssinia and had waged a series of seesaw campaigns along the deserted or thinly peopled southern shore of the Mediterranean between Egypt and Tripoli. The United States had abandoned strict neutrality and was moving toward war in alliance with Britain but was moving slowly and in an atmosphere not of assurance but of hesitancy and internal debate. Meanwhile the main thing was that the German Air Force had cut its losses over England, while the German Army, fresh from its long run of almost bloodless victories, was destined to win further successes.

The first German move of the year, a southeastward advance into Yugoslavia and Greece, seemed preliminary to an advance into Turkey toward Syria and Suez, in concert with the small but high-quality German force already operating in the Libyan Desert. The rugged mountains of Yugoslavia and Greece were the scene of German victories as rapid and bloodless as those in Poland and in the West. Again the powerful coöperation of the German Air Force and the astonishing mobility of German armor told the story. Also Yugoslavia—like so many others!—was a divided nation. Rather than leave the Greeks and Yugoslavs wholly unsupported, the British had landed a little expeditionary force which was all they could spare from their modest North African army. Like its comrades in Norway and France, this small body was roughly handled and had to retreat hastily to its ships.

Next, in another short campaign of high technical interest, the *Luftwaffe* provided both transport and flying artillery support for an attack on the British garrison of Crete. First the few British planes available were either destroyed or driven to Egypt. Without air cover, the British fleet in the 60-mile strait between Crete and mainland Greece suffered severe losses from air attack until it, too, was withdrawn. After hard fighting, during which German planes made British troop movements by day almost impossible, the ably commanded British garrison was defeated. Again an appreciable proportion of the survivors were evacuated by sea, this time in small naval craft which approached the south shore of the island by night.

From the beginning in Poland to the end of the campaign in Crete the Germans admitted a total permanent loss of less than 115,000 soldiers and airmen. There is at least some reason to believe these figures. If they represent only half the truth, the first of June 1941, after nearly two years of war, saw German man power hardly scratched. If the truth were three or even four times the admitted figure, still such a loss would have been not only supportable but moderate by 1914-1918 standards.

What might have happened had the duel between British sea power and German land power continued on the same lines we shall never know, for on the fateful day of June 23, 1941, German armies, supported by Italian, Rumanian, and Hungarian auxiliaries, invaded the U.S.S.R., thus changing the whole character of the war.

The chief reason why the Germans expected a not-too-costly victory over the government of the great Russo-Siberian land mass, comprising about a sixth of the world's land area and about a seventh of its population, must have been that they overestimated the internal divisions within the Soviet state and underestimated the strong national patriotism which invasion of the soil of what had been Holy Russia would stimulate throughout the Russian people. Probably they also underrated the efficiency of the Red Army.

In any event we can only wonder why the German Government and High Command, no matter how good they thought their information of Russia to be, deliberately plunged their country into a 2-front war without first trying to dispose of their existing enemy, England.

WHAT followed is clear only in outline. The great size and bad internal communications of Russia, which had under very different conditions defeated Napoleon, made it obviously impossible to destroy the Soviet armies in one or two lightning strokes. Hence the invaders planned a succession of such strokes. Each they began by achieving local air supremacy over a considerable frontage and depth. Next they would surround great bodies of Russians by driving deep tank wedges into their lines and then connecting those wedges across the rear of the Soviet units which were their objective. They themselves called the last stage of such an operation a *Kessel; i. e.,* the driving of hunted animals to a central point by enclosing them within a circle of beaters and then contracting the circle.

This method yielded considerable successes but fell short of a total decision. The Germans conquered vast territories and inflicted losses which would have paralyzed any Central or West European nation. They claimed millions of prisoners. They thrust to within sight of St. Petersburg, now called Leningrad. They threatened Moscow. Nevertheless, December saw them retreating a short distance into winter quarters, leaving considerable Soviet armies still intact.

By their own later admission, this incomplete result cost them nearly 900,000 permanent losses in soldiers and airmen, practically all of them in Russia. They had multiplied their own previous casualties by 7½, while the Soviet state, although severely wounded, still stood.

On December 7, 1941, the Japanese air attack upon the U. S. fleet in Pearl Harbor again transformed the war. (Editor's Note.—In a subsequent article, Major Nickerson will continue his analysis of World War II from Pearl Harbor to the present day.)

The Ordnance Affiliated Units

Our Automobile Dealers Meet the Demand for Skilled Personnel

Col. C. Wingate Reed

In July 1939, the military personnel of the Ordnance Department numbered 356 Regular officers and 2,644 enlisted men. By February 1942, this force had expanded to 3,000 officers and 43,000 men which meant that the Department's experienced personnel, especially men trained in automotive maintenance, were spread dangerously thin. At this critical time "affiliated units" were organized from civilian groups with the National Automobile Dealers Association as the chief sponsor, recruiting 950 officers and 26,000 enlisted men and making possible fulfillment of the Ordnance pledge to "Keep 'Em Rolling!"

ALL readers of ARMY ORDNANCE are familiar with the vast procurement and production program of the Ordnance Department. They are also familiar with the miraculous manner in which this program has been accomplished—the achievement of the Industry-Ordnance team. There is, however, another phase of Industry-Ordnance coöperation that is not so well known. This is the phenomenal support given the Ordnance Department by the automobile and heavy motor dealers and agents in recruiting supply and maintenance personnel. It began in the early months of 1942, when Ordnance production had reached a point where matériel of all types, including tanks, half-tracks, armored cars, and guns of all calibers, was beginning to flow to combat units in large quantities. Unfortunately for the Ordnance Department, which has the responsibility for maintenance of this matériel as well as for its supply, the flow of trained personnel was not equal to the flow of matériel.

In July 1939, just before the beginning of the expansion of the Ordnance Department to meet the obvious pending emergency, the military strength of the Department was 356 officers and 2,644 enlisted men. There also were approximately 100 officers and 700 enlisted men in the 12 National Guard maintenance companies and division headquarters which were not yet on active duty. The Ordnance Reserve consisted of approximately 3,000 Reserve officers. This was a small force to shoulder the vast responsibilities and duties which fell upon the Department.

By February 1942 this force had expanded to approximately 3,000 officers and 43,000 enlisted men on duty with all components of the Ordnance Department, including headquarters and units of the Ground and Air Forces. This meant that the Department's trained personnel were spread dangerously thin. The older trained units had been divided and redivided to form the nuclei or cadres for new units. The facilities of the Ordnance School and the Ordnance Replacement Training Center at Aberdeen Proving Ground, Md., were inadequate to meet the demands for trained Ordnancemen. New training facilities were planned, and some were even under construction, but their product would not be available for duty for many months.

Many plans for securing this much-needed maintenance personnel were considered and rejected before it was finally decided that the "Ordnance Affiliated Unit" was the correct answer. To the Ordnance Department and to the War Department as a whole, the term "affiliated unit" was new. No one understood the full import of its meaning. Army Regulations were carefully checked to see how the "affiliated unit" was to be handled. Just once was the term found, but this reference gave no detailed information as to how the units were to be managed, so the problem became one of pioneering.

This meant the forming of potential military units from civilian organizations which would sponsor them or to which they could be affiliated. The immediate need of the Ordnance Department was for two base regiments. This meant that approximately 300 officers and 5,000 enlisted men had to be drawn from industry, for no civilian organization was found large enough to stand the drain of this number of technical employees and still continue to function. It was finally decided that the National Automobile Dealers Association was an organization of sufficient scope to assume responsibility for recruiting the required men. Theirs was an organization of nearly 40,000 dealers and affiliated operators. Then came the task of persuading the officials of the Association to accept this grave responsibility. At first skeptical, when the problem was presented to them as a patriotic duty, they volunteered to assist.

On March 14, 1942, authority was obtained from the Secretary of War for the Chief of Ordnance to negotiate and arrange an affiliation of two Ordnance Base Regiments with suitable commercial organizations. The president of the National Automobile Dealers Association, Harry Sommers, Atlanta, Ga.; Dave Castles, treasurer, St. Louis, Mo.; W. L. Mallon, Newark, N. J., chairman of the Legislative Committee; and Herman Goodin, first vice-president, Huntington, Ind., acting for the NADA, obtained approval of the association's executive committee. Then the real work began.

TENTATIVE tables of organization for the regiments had been made and were approved. Mr. Goodin, first as a civilian consultant and adviser, and later as an officer, came to the Ordnance Department for full-time assistance. As an initial effort, nearly 40,000 letters were prepared and sent out by National Automobile Dealers Association headquarters advising all dealers and associates of the part the association was to play. Enclosures to this letter included a statement by the Chief of Ordnance presenting the problem, and an explanation by Mr. Sommers as to what the association would do to help.

As initially organized, the Ordnance base regiment consisted of the headquarters, three maintenance battalions, and an ammunition and supply battalion. It was decided the regimental commander should be a Regular Army colonel, but that all battalion commanders and all other officers of the battalions and companies should be procured through affiliation. On this basis one maintenance battalion was assigned to each of the six vice-presidential areas of the NADA. The ammunition battalion was to be recruited as an over-all requirement from the three areas assigned to each regiment.

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An Ordnance Unit Somewhere in France Checks and Services Tanks and Armament

Col. D. C. Cabell was selected as commanding officer of the 301st Ordnance Base Regiment, and three NADA vice-presidential areas, with headquarters in Chicago, Denver, and San Francisco, were assigned this regiment. Col. W. R. Slaughter was selected as commanding officer of the 302nd Ordnance Base Regiment, and the three remaining areas, with headquarters in New York, Atlanta, and Dallas, were assigned this regiment.

Colonels Cabell, Slaughter, and Goodin, then in a civilian capacity, immediately began a circuit of all area headquarters and intermediate points. Newspaper and radio publicity was given the campaign all over the United States. The first mission was to select six battalion commanders from outstanding dealers throughout the six areas. Meetings, attended by leading dealers, were held in the headquarters of each area. Candidates for appointment as commanding officers for each battalion were interviewed by the regimental commander and Colonel Goodin. Enthusiastic support was given the various candidates by the dealers of their particular areas.

For the 301st Regiment, Colonel Cabell selected Lieut. Col. Albert P. Baston of Minneapolis for the battalion from the Chicago area, Lieut. Col. William S. Venn of San Francisco for the battalion from his area, and Lieut. Col. Samuel Marcus from the Denver area. For the 302nd Regiment, Colonel Slaughter selected Lieut. Col. William M. Crofton of New York for the battalion from that area, Lieut. Col. Tom Wolfe of Albemarle, N. C., for the battalion from the Atlanta area, and Lieut. Col. C. M. Johnson of Dallas for the battalion from that area. The commanding officers for the ammunition battalions were selected later.

EVEN at that early date, these two regiments were destined for the North African Theater, via England. It was thought at that time they would be required by July, leaving but three months to recruit, equip, and train them. A decision had to be made immediately whether maximum time was to be allowed for recruiting with less time for training, or if recruiting was to be rushed and training favored. It was decided to recruit the men as quickly as possible, get them into camp immediately, and give them all the training possible.

This decision, while still believed to have been the best under the then-existing circumstances, resulted in many unforeseen emergencies. This was due to the inexperience of both officers and men. In a period of 60 days, approximately 350 officers and 8,500 enlisted men were recruited for the two regiments. The zeal with which the dealers went into the job of recruiting resulted in a sizable oversubscription. Overzealousness on the part of recruiting officers and dealers, coupled with a very limited knowledge of the Army, also resulted in many promises being made to recruits which later were very difficult to keep. However, as a whole the venture was an overwhelming success.

CAMP SUTTON, located on the outskirts of the little town of Monroe, N. C., will live long in the memory of all connected with the 301st and 302nd Regiments. Here the officers and soldiers alike made their first contact with Army life. Camp Sutton was a new temporary divisional camp without a sewage system and with many hardships neither officers nor men had experienced before. Here these newly recruited soldiers were hardened and rounded into American fighting men. And it was done the hard way.

The local high school, the State Guard armory, shops, and warehouses were converted into training facilities for the two regiments, and matériel was procured from every possible source. Ingenuity was the order of the day. Men who had never seen a machine gun before enlisting were studying the handbook at night and teaching others the next day. The ability and skill of these men, selected from the automobile-maintenance shops of the United States, were first demonstrated to the military at Camp Sutton, and their conduct since that time has fully sustained the first impressions they made. Indeed, the success achieved in raising the 301st and 302nd Base Regiments was such that when a demand arose for maintenance battalions for new armored divisions and for a large number of heavy- and medium-maintenance companies for the Ground Forces there was no question but that the "affiliated unit" was the only answer.

To avoid the mistakes made in early recruiting, new methods were developed. Officers were first selected and sent to school for their basic military training, then returned to their own communities to assist in raising their units. As it became increasingly evident that the quality and quantity of officer and enlisted man power available justified an all-out effort, a recruiting force of sufficient size for the job was

raised and specially trained for this work. Manning charts, giving job descriptions for each position on each table of organization, were perfected to assist the recruiters. A definite policy was established of recruiting the noncommissioned officers in grades lower than the ones shown in the tables of organization. This permitted commanding officers later to select the most qualified men for promotion. With the availability of trained recruiting teams, the officers of a unit were selected, commissioned, and sent to basic training prior to the activation of their units. These officers had nothing to do with the selection of the personnel for their units. This eliminated previous tendencies toward favoritism in the selection of noncommissioned officers.

Of inestimable value were the state and city committees formed by the NADA. Forty-three separate state committees, a District of Columbia committee, and a metropolitan New York Committee, not to mention many other separate city committees, gave freely of their time, money, and influence to make the recruiting of these units a success. Salesrooms were thrown open as recruiting centers, newspaper advertising was bountifully supplied, radio time was given, but most valuable of all was the personal interest and effort of the committeemen and dealers. This personal selection of men and approval by the committeemen was the essence of the entire program.

While it is beyond the scope of this article to enumerate all the many and ardent workers who gave so liberally to this activity, there were certain outstanding enthusiasts who can never be left out when the story of the Ordnance Affiliated Units is told. In addition to those already mentioned there are E. O. Thomas of North Carolina, Joe Mitchell of Texas, Walt Hamer of Ohio, A. H. Jones of Nebraska, A. J. Dingeman and Capt. Billy Hughson of California, Claud Klugh of Pennsylvania, Cliff Bishop and C. S. Forsythe of New York, Art Summerfield and Paul Graves of Michigan, and so on through a long list of men who put patriotic duty and service before personal gain.

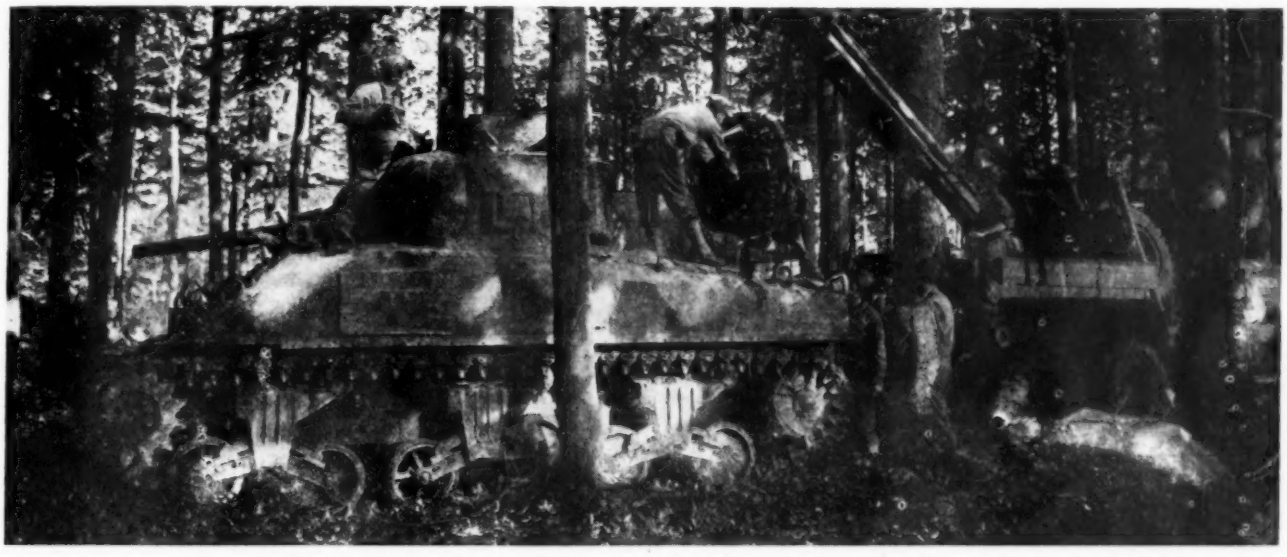
Too much credit cannot be given to the impetus given this campaign by William E. Holler, general sales manager of Chevrolet. Sixteen state directors of NADA are Chevrolet dealers. These dealers were given every possible support by Mr. Holler in the formation of committees. They held "booster" luncheons, made extensive use of newspaper and radio publicity, and did much to obtain civic coöperation.

Early in the recruiting campaign it was realized that an organization, even of the magnitude of the NADA, would not be large enough to raise all the units that had to be raised by this method. With this in mind, additional affiliations were formed with the International Harvester Company, the American Roadbuilders Association, Allis-Chalmers Company, the John Deere Company, the Associated Equipment Distributors, and the J. I. Case Company. The coöperation of the officials in each of these organizations was most outstanding.

THE NADA naturally took the leading rôle in this activity recruiting the personnel for 4 base regiments, 11 battalions, and 91 separate companies, totaling approximately 950 officers and 26,000 enlisted men. International Harvester Company, with the personal sponsorship of Fowler McCormick and the active guidance of F. M. Peckles, raised 2 battalions and 5 separate companies for a total of 57 officers and 1,575 enlisted men. Bob Eaves of the Washington office, as liaison officer between Ordnance and the company, gave invaluable service. The American Roadbuilders Association, under the enthusiastic direction of Charles Upham, its engineer-director, and with the close support of many state highway organizations, raised 11 heavy-maintenance companies for a total of 40 officers and 1,200 enlisted men.

The John Deere Company, under the supervision of P. E. Wadsworth, raised one battalion of the 303rd Base Regiment; the Associated Equipment Distributors raised Company "B" of the Maintenance Battalion, 14th Armored Division; and J. I. Case and Allis-Chalmers each contributed an excellent heavy-maintenance company.

By late fall of 1942, the Ordnance training facilities had increased sufficiently to provide personnel and units to meet the Department's needs. Both the training center at Flora, Miss., and the training center at Santa Anita, Calif., had been added to the Aberdeen capacity. On December 15, 1942, the "affiliated-unit" recruiting activities were brought to an end. Approximately 1,200 officers and 30,000 enlisted men had been recruited to man a total of 5 base regiments, 10 separate battalions, and 109 separate companies.



SOMEWHERE IN GERMANY, ORDNANCEMEN INSTALL A NEW RADIAL ENGINE IN AN M4 MEDIUM TANK

The New Rocket Launcher M12

A new "superbazooka," the Army's M12 rocket launcher has been designed to fire a 38-pound 4.5-inch rocket having the destructive effect of a 105-mm. high-explosive artillery shell. As shown in these official Army photos, the new 22-pound launcher with its rocket can be carried by one man and set up easily in the field on its simple tripod mount.

Incendiary Bombs

Pine Bluff Arsenal's Contribution to Aërial Warfare

Brig. Gen. A. M. Prentiss

To meet the demand of the British air forces for increased quantities of incendiary bombs and to enable the United States to wage incendiary warfare successfully should the need arise, Pine Bluff Arsenal, Ark., was activated on November 21, 1941, and ground was broken and construction started 5 days before Pearl Harbor. Since that time, the arsenal has turned out increasing numbers of 4-pound incendiary bombs and in June 1944 exceeded its production forecast by 8 per cent.

ONE of the most effective weapons of destruction produced in World War II is the incendiary bomb dropped from aircraft. While incendiary bombs were introduced first in World War I by the Germans, they were of very crude design and were not developed to a point of real effectiveness before the end of the war. However, in the two decades between the two World Wars much intensive effort was devoted to the perfection of incendiary weapons and particularly of incendiary drop bombs.

Upon the outbreak of the present war, the Germans commenced the use of a very effective type of incendiary, known as the "Electron" bomb. It weighs one kilogram (2.2 pounds) and consists of a metallic magnesium body filled with thermite. One medium bomber can carry from 1,500 to 2,000 of these small bombs and, by scattering them over a suitable target area, can start simultaneously scores of fires with each flight of a single plane. By concentrating several squadrons of bombers on large cities, widespread conflagrations are obtained and enormous damage inflicted. In fact, these fire bombs are limited in effectiveness only by the amount of combustible material present and, of course, by the efficiency of the enemy's fire-control measures.

The use of incendiary bombs on rear-area targets, particularly large cities, increased in volume and effectiveness as the war progressed. The German incendiary attacks on England reached their climax in the devastating raids on London in the winter of 1940-1941. But these early German raids pale in comparison with the incendiary attacks now being made by the allies on Axis territory. Recent newspaper reports speak of more than 1,000,000 incendiary bombs being dropped within 42 minutes during a single night raid over Germany.

Even before the United States entered the present war, the use of incendiary bombs by the British air forces had already reached a point where a sufficient quantity to meet requirements could not be manufactured in England, and the British Government consequently placed orders for large quantities of these bombs in the United States. To meet this demand and to place ourselves in a position where we could successfully wage incendiary warfare from the air, it was decided early in the fall of 1941 to provide a Government arsenal for the manufacture of incendiary bombs in addition to commercial production.

On November 21, 1941, Pine Bluff Arsenal (near Pine Bluff, Ark.) was activated officially, and five days before Pearl Harbor ground was broken and construction of the arsenal started. Since the arsenal was to be operated by the War Department rather than by contract with a private concern, all the necessary post facilities, such as barracks, quarters, commissary, and other elements of a military station had to be provided, together with a hospital to care for both civilian and military needs. Construction contracts were under the Corps of Engineers, and the firm of Sanderson and Porter performed both as architect-engineer and as general contractor.

The largest branch of Pine Bluff Arsenal's Production Division is known as the incendiary bomb filling (IBF) branch, which comprises three incendiary-bomb plants, all designed to make 4-pound magnesium aircraft bombs. This bomb is an edition of the German 1-kilo (2.2-pound) "Electron" bomb. The American 4-pound magnesium bomb M50 consists of an outer shell or body of cast metallic magnesium with a cast-iron nose, into which are filled two incendiary mixtures called "Thermate" and "First Fire 20." The bomb is approximately twenty-one inches in length and its hexagon-shaped body is two inches in diameter.

When this bomb strikes an object, the filling composition is ignited and burns fiercely at a temperature of about 3,000 degrees Centigrade for approximately one minute, melting and setting fire to the magnesium casing. The molten magnesium, which is the principal incendiary agent, burns for ten to fifteen minutes and sets fire to anything inflammable within several feet. During the first minute, while the thermate composition is burning, the bomb reacts very violently; jets of flame are emitted from vent holes, and pieces of molten magnesium may be thrown as far as fifty feet. The thermate composition contains its own oxygen and so cannot be extinguished by water or sand, but the magnesium must get its oxygen from the air or surrounding materials in order to burn.

MANUFACTURE of incendiary bombs at Pine Bluff Arsenal is performed by a roller-conveyor assembly-line system that permits rapid production on a large scale. Each worker is assigned a specific job and accomplishes that specific step in the manufacture of the bomb day after day. Procurement of raw materials, proper mixing or blending of the chemical ingredients into empty bomb bodies, final assembling, clustering the individual bombs, and packing—these are the general steps involved in the production of the bombs. Raw materials and component parts of the bomb are shipped to the arsenal directly from manufacturing concerns throughout the country. These include the empty casings or bomb bodies, firing pins, primers, detonators, and the ingredients of the chemical fillings.

A trip down the arsenal production lines of the incendiary bomb filling branch would show every employee doing the "little jobs" that make up the big picture of bomb produc-

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General Prentiss is the Commanding General of Pine Bluff Arsenal, Ark. Lieut. B. A. Shapero, A. G. D., assisted in the preparation of this article.

tion at the arsenal. In the mix buildings, an area set off by itself, the chemical fillings are mixed and blended for subsequent insertion into the bomb bodies in another building. Thermate, the bulk of the filling material, is a mixture of commercial thermite, powdered aluminum, barium nitrate, and petroleum oil. Its "partner in fire," the increment called "first fire mix," is used to ignite the thermate. After blending in equipment resembling cement mixers and tumbling barrels, the thermate is transferred in 60-pound cans to the "fill and press buildings" where it is—as the name implies—filled and pressed into the bomb casings. The first fire mix is transported in smaller cans because of its more highly combustible character. First fire mix is so delicate that it has been known to flash on pouring or on the slightest frictional impact.

THE magnesium casings are already at the head of the fill and press lines waiting to be processed when the thermate and fire mix arrive at the fill and press buildings. In outward appearance, the bomb body is a hollow magnesium tube about two inches in diameter with a central bore about one inch in diameter, on one end of which has been cast an iron nose about two inches long to give it more stability in flight after it is dropped from the plane. Small holes are drilled in the wall of the bomb near its open end to permit insertion of a safety plunger which prevents accidental ignition of the bomb. This end also contains three small vent holes which are plugged and waterproofed and which, upon ignition, are blown out to permit escape of the flame and gases produced by the bomb.

The empty bomb bodies are inserted, open end up, in pallets which carry them along the assembly lines where workers fill and press the incendiary fillings into them. Each pallet contains eight bombs and is carried along the assembly lines on a power-driven conveyor. The thermate is placed into the bomb in three separate batches or increments. After each increment is added, it is pressed by an hydraulic press to insure required consolidation. When the three increments of thermate have been filled and pressed into a bomb body, an increment of first fire mix is added and pressed in similar manner. The once-hollow magnesium casing is now packed with "chemical fire" and is ready for final processing.

After inspectors have assured themselves that the filling and pressing of the thermate and first fire mix are in accordance with specifications, the bombs continue along the conveyor to cubicles where the final operations are performed on their assembly. Here the primer and firing-pin assemblies are added and the tail assembly inserted and riveted to the bomb body. This tail, acting like the feather in an arrow, ensures true flight in the downward path of the bomb to the target. After another inspection the bombs are packed in convenient-sized boxes and transported by industrial tractors and trailers to the packing building where the last steps in the manufacturing process are completed.

For greater precision in bombing, the individual incendiary M50 bombs are assembled into 500-pound (M17) clusters. Each cluster contains 110 of the small bombs, and all of these can land within a 100-yard square when dropped from the air. A time fuze on each cluster sets off a detonating cord which bursts the cluster, causing the bombs to spread out in umbrella fashion and burn anything combustible which they contact in the target area. The M17 aimable clusters assembled at Pine Bluff Arsenal are an improvement over previous quick-opening incendiary bomb clusters because they can be dropped from a plane in the same manner as high-explosive bombs, thus shortening the bombing run. This materially reduces the bomber's vulnerability to flak and enemy fighter attack, usually most concentrated around the target.

THE clusters of magnesium incendiary bombs are said to be high among the most destructive weapons carried by allied bombers. A single medium bomber carries 660 incendiary bombs in clusters on missions over enemy territory. A medium bomber carries 6 clusters of 110 bombs each. Effectiveness of these incendiary bombs is demonstrated by the extensive areas that are more or less completely burned down in enemy cities, as shown by aërial photographs after our bomber raids.

Constant inspection all along the lines and final testing of the finished munitions by a special proof-test section reduce the possibility of "duds" to a minimum. Specimens of the chemical ingredients used in filling the bombs are submitted to the arsenal laboratory periodically for a thorough check analysis and test. On the lines, workmanship is inspected to see that every specification for the manufacture of the bombs has been met.

As part of the inspection program, bombs are dropped daily from a 30-foot drop-test tower to make sure they will function and burn. Sample clusters of bombs are then dropped from a bomber and skated into a concrete wall by planes traveling 250 miles an hour. Clusters are also dropped vertically from planes at 4,000 to 5,000 feet. Workers in the proof-test section check results with extreme care. Ninety to ninety-five per cent of the incendiaries must function before a lot is accepted.

The production of magnesium incendiary bombs is at best a hazardous process. Accidents can take a toll of man-hours with a consequent slowing down of production, so safety measures predominate wherever and whenever possible. Specially trained safety instructors, foremen, and workers, who devote full time to these duties, function in every section and building of the incendiary branch. Safety workers enforce safety regulations, eliminate job hazards and unsafe practices, oversee the wearing of protective clothing, such as safety shoes and flame-retardant clothing, and are responsible for the training of every employee in the incendiary branch.

In the buildings where the bomb bodies are filled and pressed with the highly combustible increments, water sprays are installed on every press. Should a fire break out, the simple pulling of a lever by the operator sprays water on the bomb pallets to control the flame quickly and prevent its spread. Water hoses and first-aid equipment are placed in every important building throughout the area. Buildings are of reënforced concrete fireproof construction and are subdivided into small cubicles, each separated by safety doors to prevent the spread of flames.

The part played by women in vital war production becomes obvious to even the most casual observer who sees the production lines in operation at Pine Bluff Arsenal. Approximately seventy per cent of the jobs in the incendiary branch are filled by women. They range in ages from 18 to 60, and work as mechanics, munitions handlers, drivers, foremen, etc.; they are clerks, stenographers, secretaries; they cluster the aërial bombs; they crate and pack and ship. In short, they perform almost every step in the manufacture of this much-needed and most effective weapon. They seem to remain unsung to the public, but to any one who has seen them at work they are among real heroes of World War II.

With Smoke and Flame

CHEMICAL warfare has become a front-line job on today's far-flung battlefields. Wherever an enemy pillbox cannot be silenced by high explosives, wherever troops must be screened from the fire of the enemy, or wherever incendiaries are needed to burn hostile installations, there you will find men of the Chemical Warfare Service clearing the way with flame throwers and incendiary grenades or creating huge clouds of protective man-made fog.

The Chemical Warfare Service is one of the youngest and one of the most effective elements of America's modern Army. It originated in the first World War as a result of German introduction of gas, the flame thrower, and aërial incendiaries as battle weapons, and it served with such distinction during that conflict that it was made a permanent branch of the Regular Army in 1920.

The Service is unique among the branches of the Army in that it is intimately identified with its own material from test tube to the test of battle, and it is the only branch that conceives, manufactures, and uses its own weapons. It also furnishes the Ground and Air Forces with personnel, matériel, and training in the highly specialized art of chemical warfare.

The Chemical Warfare Service produces all the incendiary bombs showered by our Air Forces on military targets in Europe and the Pacific theaters as well as the incendiary grenades used in ground fighting. It also provides the apparatus and ingredients, and in many cases the operating troops, which establish the smoke screens to protect our troop movements and vital installations. These include smoke generators for ground and air use and smoke grenades and smoke pots for field use. The rifled 4.2-inch chemical mortar—developed, made, and used by the Chemical Warfare Service—is another effective weapon. It is a portable, quick-firing mortar that can drive the enemy out of the ground with burning phosphorus, blast him in the open with high explosive, and blind him with clouds of heavy smoke.

The flame thrower, too, has played an outstanding part in this war, particularly in the Pacific, where it has routed the stubborn Jap from pillboxes and machine-gun nests when all other means have failed.

In addition to these developments, the Chemical Warfare Service, in preparation for possible use of gas by the enemy, has amassed great stores of this agent, provided various types of weapons for its release, trained troops in its defensive and offensive phases, and furnished our fighting men with the world's best gas masks, protective clothing, and other anti-gas devices.

Besides being responsible for all chemical-warfare items, some of which are shown in the accompanying Signal Corps pictures, the Service must see that this material is used to the best advantage. So wherever our forces are fighting—in the air, on the ground, and even on the sea—will be found Chemical Warfare equipment and personnel trained to use it for the speedy defeat of the Axis in Europe and in the Pacific.

Flame Thrower vs. Pillbox

When high explosives fail to reduce an enemy pillbox, the flame thrower is called into action while riflemen cover the ports and keep down enemy fire as shown above. The flame thrower has a range of 20 to 60 yards and comprises fuel-oil and compressed-air tanks carried on the back and a cylinder o hydrogen under the gun for igniting the oil as shown below.

The "Goon Gun" in Action

The 4.2-inch rifled mortar, shown above firing high-explosive and white phosphorus in the European theater, has a range of 600 to 4,500 yards and can fire twenty 24-pound shells a minute. Below is a 4.2-inch mortar squad firing high explosive at Jap positions 2 miles away on Arundel Island in the New Georgia group. Firing data are received by telephone.

Decontamination Squads at Work

In event of enemy use of gas, the Chemical Warfare Service is well prepared with passive as well as active means of defense. Decontamination squads, equipped with gas masks and impermeable clothing, can clear large areas of toxic gases in a short time with apparatus, such as that shown above, while crews with hand equipment (below) mop up local sites.

Protection from Chemical Attack

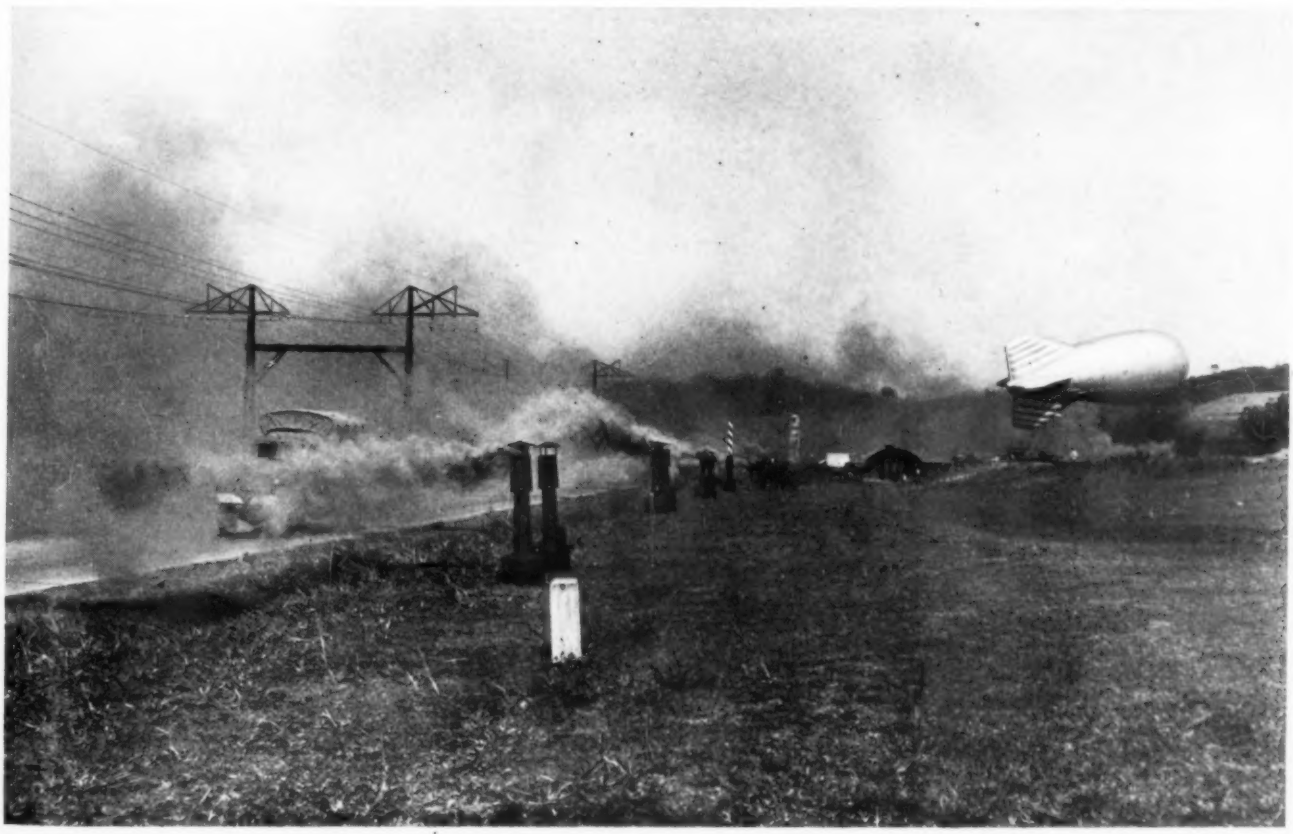
War gases may be sprayed on ground troops by airplane as shown above, and American soldiers are well trained in instant use of the gas mask. Additional protection is given by the use of gas capes as illustrated below. These capes are carried in a small package and may be opened and donned in a few seconds. The transparent top permits a view in all directions.

Mobile Fog Makers

The mobile smoke generator M1, above, can produce a huge cloud of dense smoke in a few minutes and is used to blot out airfields, cities, and large permanent installations. The generator M2, shown below mounted on a jeep trailer, is adapted for front-line action. Called the "foxhole generator, it can obscure an area 5 miles long and 200 yards wide.

Smoke Screens for Air Defense

Smoke generators are shown above in action blotting out the harbor area and part of the city of Palermo, Sicily, as a precaution against hostile air attack, while the smoke pots shown in the illustration below are used to conceal a vital highway and power installations near Fort Clayton in the Panama Canal Zone. Smoke screens supplement active air defense.



Incendiary Bombs

Fire bombs average more than 60 per cent of all American bomb loads in the European theater. Above, Chemical soldiers are loading 500-pound clusters of magnesium bombs into a B-24 Liberator, while in the Air Forces photo below, two of the clusters are on their way. Each contains over 100 incendiaries and breaks open to scatter them like huge matchsticks.

The Age of Gunpowder

The Influence of Armament on World History — IV

Maj. Gen. J. F. C. Fuller

By ousting an old system of warfare, gunpowder created a new system of peace. In the sixteenth century it revolutionized not only the method of fighting but also the way of living and, in consequence, civilization itself. With the advent of firearms we do not merely turn over another page in human history; instead we open a portentous new volume—the title of which is "The Will to Power."

WITH the discovery of gunpowder, a substance unknown to the ancients, we pass into the technological epoch of war, the hidden impulse of which is the elimination of the human element both physically and morally, intellect alone remaining. As Lecky points out,[1] hence onward it is the great inventions more so than the great men which disturb and accelerate the process of society.

Valor gives way to mechanical art. He who wields the superior weapon is the more formidable foe, irrespective of his social status or his courage. For, as Carlyle has said, the genuine use of gunpowder is "that it makes all men alike tall."[2] In short, it democratizes fighting.

Thus, by changing the character of war, gunpowder changed the medieval (Christian) way of life. The search after the perfecting of weapons and of defenses against them gave birth to a spirit of inquiry which soon embraced all things in general. It was gunpowder, more so than contact with Islam during the Crusades (1096-1444) or the fall of Constantinople in 1453 which gave life to the Renaissance, because it shattered the medieval order both physically and morally.

The idea that war is a trial of moral values by battle in which the Church referees for God is replaced by a new certainty—that war is a means toward a political end, in which the deciding factor is power. As war was secularized, peace followed suit, idealism giving way to realism. For instance, by the end of the fifteenth century we find such noted soldiers as the Condottieri Gian Paolo Vitelli and Prospero Colonna declaring that "wars are won rather by industry and cunning than by the actual clash of arms."[3]

Not only, as we shall see, did gunpowder blast the feudal strongholds but also the ideals of their owners. As portable firearms were multiplied, the medieval contempt for unmounted troops was undermined, until in tactical importance foot soldiers were raised to the level of the mounted men-at-arms. Thus it came about that, whereas among the feudal knights, ruses of war, surprisals, pursuits, and even the exploitation of the enemy's defeat were considered dishonorable and unchivalrous, they now became customary until Machiavelli (1469-1527) goes to the length of saying: "Although in all other affairs it is hateful to use fraud, in the operations of war it is praiseworthy and glorious."[4]

This moral debacle—the antithesis of all the Crusades had stood for—reached its zenith in the sixteenth century when Francis I (1515-1547) and Henry II (1547-1559) of France, in order to further their aims against the Emperor Charles V, went into alliance with the Turks, the common enemy of Christendom.[5]

Such were the results of the discovery of gunpowder by Roger Bacon (1214-1292) in his half-magical laboratory. Anyhow, it is he who, in his "Epistolae de Secretis Operibus Artis et Naturae et de Nullitate Magiae," written before the year 1249, has left to us its earliest receipt. And because, as Colonel Hime points out, without saltpeter there can be no gunpowder, and as no mention of saltpeter is made anywhere before the thirteenth century, the probability is that Bacon was the discoverer of that explosive. His formula was hidden away in the following cryptogram: "Sed tamen salis petre *luro vopo vir can utriet* sulphuris." Rearranging the letters of these strange words, we get "RVIIPARTVNOUCORULVET," and combining them into groups we get "R.VII. PART. V. NOV. CORUL. V. ET." This makes the sentence read: "Sed tamen salis petre recipe VII partes, V novelle coruli, V et sulphuris"—"But take seven parts of saltpeter, five of young hazelwood (charcoal), and five of sulphur."[6]

Though Bacon suggests that by means of this explosive mixture an enemy's army "might be either blown up bodily or put to flight by the terror caused by the explosion," there is nothing in his writings to suggest that he ever contemplated using it in firearms. Who first thought of propelling a ball through a metal tube by exploding gunpowder is unknown; anyhow, it certainly was *not* monk Berthold Schwartz.[7]

APPARENTLY the earliest extant document mentioning cannon is one in Arabic, dated 1304.[8] Of others, two belong to the city of Ghent, dated 1313 and 1314 respectively. Also, in an illuminated manuscript of 1326, now in Christ Church, Oxford, England, there is a picture of the earliest form of cannon, "a dart-throwing vase," or, as it was also called, a "pot-de-fer." This primitive weapon appears to have been used as early as the siege of Metz in 1324[9] and by Edward III in Scotland in 1327.[10]

According to Sir Charles Oman,[11] in 1339 the first mention is made of another firearm, called "ribauld" or "ribauldequin"—a primitive mitrailleuse which consisted of several small iron tubes so arranged that they could be fired simultaneously. This weapon was used by Edward III in his war with France, and in 1387 one of 144 barrels was built, the barrels being grouped in batteries of 12 apiece, allowing 12 salvos of 12 balls each to be fired.[12] Volume fire was clearly its aim.

General Fuller is author of the following works, among others: "On Future Warfare," 1928; "India in Revolt," 1931; "Lectures on F. S. R. II," 1931; "Lectures on F. S. R. III (Operations between Mechanized Forces)," 1932; "War and Western Civilization, 1832-1932," 1932; "General Grant (A Biography for Young Americans)," 1932; "The Dragon's Teeth (A Study of War and Peace)," 1932; "Generalship, Its Diseases and Their Cure," 1933; "Grant and Lee (A Study in Personality and Generalship)," 1933; "Empire Unity and Defence," 1934; "The Army in My Time," 1935; "The First of the League Wars," 1936; "Memoirs of an Unconventional Soldier," 1937; "The Last of the Gentlemen's Wars," 1937; "Towards Armageddon," 1937; "The Decisive Battles," 1939; "Decisive Battles of the U. S. A.," 1942; "Machine Warfare," 1942; "Armored Warfare," 1943. Special correspondent, London *Daily Mail*, Italo-Abyssinian War. Major General, British Army, Retired. C. B., C. B. E., D. S. O. London, England.

[1] Reference notes are published in full on page 95.

Considering the crudeness of fourteenth-century mechanics, as well as the religious restrictions of the age, progress in firearms was rapid. In 1340, there were powder mills in Augsburg, and if, in 1346, Edward III did not make use of cannon at Crécy, as many doubt, that year they are known to have been used at the siege of Calais.[13]

By 1381, iron shot were in use, for that year mention is made of 928 of them stored in the arsenal of Bologna. Before the century was out, progress had so far advanced that it was possible to build bombards of a caliber of twenty-five inches, such as the still-existing Dulle Griete of Ghent. About this time the handgun, first heard of in 1364, was more generally adopted. It resembled a small cannon on a straight stock which could be carried and fired by a single man. It weighed about ten pounds, was fired by applying a match to its touchhole, and its bullet was of lead. Normally it was used from behind defenses, indifferent infantry being armed with it. Toward the end of the fifteenth century the handgun gave way to the matchlock, an iron barrel mounted on a stock which fitted against the chest. It was the first true infantry firearm.

SO far as armaments are concerned, the fifteenth and sixteenth centuries were marked by inventiveness. Setting aside speculative inventions, such as Leonardo da Vinci's (1452-1519) airplane, tank, and submarine, all of which were impossible until the mechanical science and arts had advanced, the following incomplete list will give some idea of the progress made: Hand grenades, 1382; smoke balls, 1405; time match, 1405; case shot, 1410; corned gunpowder, 1429; fire balls, 1400-1450; matchlock or arquebus, 1450; bronze explosive shell, 1463; explosive bombs, 1470; wheeled gun carriage, about 1470; pistol, 1483; incendiary shell, 1487; rifling, 1520; wheel lock, 1521; Spanish musket, 1521; improved hand grenades, 1536; wheel-lock pistol, 1543; paper cartridges, 1560; a type of shrapnel shell, 1573; hot shot, 1575; common shell, 1588; fixed cartridges (powder and ball in one), 1590; rifled pistols, about 1594; and percussion fuze, 1596.

The Hussite Wars were marked by a tactical development of a highly ingenious kind which went far to undermine the prestige of feudal chivalry. Faced by the full strength of the Empire, the Czechs, whose army consisted mainly of undisciplined and badly armed peasants, seemed to be in a hopeless position. Nevertheless, John Zisca, a man of tactical genius, led them from victory to victory. Realizing that his army was offensively useless, as a defense against cavalry he adopted the Russian and Tartar wagon laager, turning it into a movable fortress—the Wagenburg—and defending it by means of hand gunners. He was the first general who specialized in this arm, his tactics consisting in letting his enemy attack his mobile castle and when he was exhausted to issue forth and counterattack him. By means of these defensive tactics the Czechs won battle after battle, their most notable victories being those of Deutschbrod, 1422; Aussig, 1426; and Tachau, 1427.

At the Battle of Formigny, fought in 1450, tactics were the reverse, for it was the gun coupled with the offensive which won. The English, some 4,500 strong, under Sir Matthew Gough and Sir Thomas Kyriel, were faced by an equal number of Frenchmen commanded by the Count of Clermont. As was normal throughout the Hundred Years' War, the English, covered by their archers, awaited attack. Thereupon, after some initial skirmishing, Clermont ordered Giraud, Master of the Royal Ordnance, to bring up two culverins and enfilade the English archers. The effect of their fire was so galling that part of Gough's and Kyriel's army rushed forward and captured them; but, unsupported, they were driven back. Whereupon the French men-at-arms attacked the now disorganized English, burst through their ranks, and all but annihilated them, leaving no less than 3,774 dead on the field.

IT was, however, at the siege of Constantinople in 1453 that the cannon proved itself to be the dominant arm. On April 5th, Mohammed II, the first great gunner in history, at the head of an immense army, appeared before the city and planted his cannon opposite its triple land wall. There, on the 12th, amidst the beating of drums and the shouting of thousands of excited men, the first of the great historical bombardments opened. Of it Mijatovich says: "Since the creation of the world, nothing like it had been heard on the shores of the Bosphorus."[14] Yet it was a slow affair, for as it took two hours to load them, the great cannon could fire but seven times a day.

Mohammed's most formidable pieces were bombards cast for him by a Hungarian or Wallachian cannon founder named Urban. They threw stone shot thirty inches in diameter, weighing from 1,200 to 1,500 pounds.[15] These clumsy pieces required 60 oxen to drag them, 200 men to march alongside and keep them in position, and 200 more to level the road.[16] In all, Mohammed had 14 batteries, consisting of 13 great bombards and 56 smaller cannon of various kinds.

On Tuesday, May 29th, after a breach had been made, Constantinople was carried by storm. Thus ended the Eastern Roman Empire, and thus was created Turkey in Europe.

In the West, as in the East, and in spite of its crudeness, the cannon was forcing decisions still unequaled in the days of its perfection. Like Mohammed, Charles VII of France, relying on artillery, raised a siege train, and with it he reduced the English strongholds in an incredibly short time. As Sir Charles Oman points out: "In the reconquest of Normandy in 1449-1450, the French conducted sixty successful siege operations in a year and four months."[17]

Also Sir Charles writes: "The same complete mastery of modern cannon over old fortifications was seen in England during the Wars of the Roses" (1455-1485).[18] These wars not only placed Henry Tudor on the throne but resulted in so deep-rooted a dislike for the professional soldier that for 150 years England was left without an army and precisely during those years when technical military organization on the Continent was becoming a science.

This work of castle battering reached its zenith under Charles VIII of France (1483-1498) who, by invading Italy in 1494, started the long Valois-Hapsburg struggle which, with few breaks, lasted until the peace of Le Cateau-Cambrésis in 1559. Charles' strength lay in his artillery, which was revolutionized during his reign. Gun carriages were adopted, sighting was greatly improved, schools were established for gunners, iron cannon were replaced by bronze, and lead shot by iron cannon balls.

As Taylor writes, against this organized artillery "citadels which had previously held out for months fell in a few hours."[19] And so startling were the successes gained that a general belief arose in the futility of fortifications. As we shall see, this belief was dictated by fright rather than by reason.

It was not, however, until the bloody Battle of Ravenna,

won in 1512 by Gaston de Foix over the army of the Holy League, that artillery first played a decisive part in the open field. Both sides brought their guns into action at the outset, a mutual bombardment following. As this was in progress, and whilst the guns on the French right were enfilading the Spanish left, the Duke of Ferrara maneuvered his batteries around the Spanish right and so galled his enemy that he forced him to abandon his entrenchments and come into the open. There the Spaniards were charged by Gaston de Foix; yet not until their rear was attacked did they give way, retiring under cover of the fire of their arquebusiers.[20]

IN order to neutralize the power of artillery, battlefields became more and more entrenched, as was notably the case at Bicocca in 1522 and at Pavia three years later. Further, no sooner had Charles VIII's cannon reduced the Italian castles to rubble or terrified their garrisons into surrender, than a system of fortifications was introduced which defeated the gun. Moats, walls, and towers were replaced by wet ditches, ramparts, and bastions—the last two covered by earthworks and mounting heavy guns. In 1509, at the siege of Padua, the Emperor Maximilian's artillery was completely nonplused in spite of the fact that his siege train was many times more powerful than the one brought into Italy by Charles VIII. It is remarkable that, whereas in 1494-1495, Charles, as Machiavelli wrote, "seized Italy with chalk in hand"[21]—that is, his artillery took him to whatever spot he chose to chalk on the map—from 1521 onward successful sieges became a rarity.[22]

IN this article, General Fuller—noted British soldier-author—tells of the new "technological epoch" of war and the changes in strategy and tactics brought about by the use of gunpowder from its development by Roger Bacon in the thirteenth century to the efficient and effective field artillery of Gribeauval in the last half of the eighteenth.

This is the fourth in a series of six articles being written by General Fuller for ARMY ORDNANCE *on the development of weapons through the ages and their influence on the course of civilization. The first article, "Armament and World History," appeared in the July-August 1944 issue; the second, "The Age of Valor," in the September-October number; and the third, "The Age of Chivalry," in the November-December issue. The next installment will treat of "The Nation in Arms."*—EDITOR.

This return to the defensive, coupled with the decline of cavalry and the progress in firearms, more and more brought infantry to the fore, and, as the Swiss were already in the field, pikemen were multiplied. To meet them, Gonzola de Cordova, the Great Captain, reverted to the tactics of the Roman legion. Arming his infantry with sword and buckler, in 1502, at Barletta, he defeated the Swiss in the same way as Flaminius and Æmilius Paulus had defeated the Macedonian phalanx at Cynocephalae and Pydna.

Though the sword could master the pike, it was a poor weapon against cavalry. Therefore it fell out of use, and the problem became one of how best to combine pikes and firearms, for the battle of Marignano, in 1515, had conclusively proved that the arquebus had challenged the supremacy of the pike.

It was solved by the introduction of the musket by the Spaniards, who first used it at the siege of Parma in 1521. It was an arquebus six feet in length which weighed fifteen pounds and was fired from a fork-shaped rest. Its range was 240 yards and its killing power considerably higher than the older arquebus.

The tactics of this improved matchlock were rapidly developed by the Marquis of Pescara, who has every right to be called the father of modern infantry. In 1522, at the Battle of Bicocca, he demonstrated on a large scale the value of musketeers holding a defensive position. In this battle the Imperial Army was protected by a sunken road, behind which Pescara drew up his musketeers in four ranks, massing his pikemen in rear of them. They were instructed to hold their fire until the Swiss of the French Army came within close range, when each rank was to fire in turn. This was done with complete success, and the Swiss were decimated and forced to retire.

AT Sesia, in 1524, he maneuvered his musketeers independently in the open, and, for the first time, pikemen became no more than their auxiliaries. The year following, at Pavia, the steady shooting and maneuvering of Pescara's musketeers won for the Imperialists the most decisive battle of that generation—a battle which founded modern infantry fire tactics.

Thence onward, until the introduction of the bayonet, the musket and the pike remained the dominant arms. Artillery opened the way, the pike protected the musket, and the musket cleared the road for the advance of the pike—and frequently also for the cavalry sword and lance. Thus for over a hundred years were tactics set.

This change from the medieval way of fighting to the modern was remarkably rapid, which may be seen in the change of the composition of armies. Whereas, in 1494 two-thirds of the French Army were cavalry, in 1528 no more than one-eleventh was. In the Spanish Army it was much the same: in 1503, cavalry numbered one-fifth of the total, and, in 1525, one-twelfth. So completely had the shock value of cavalry declined, that some time before 1521—the year of his death—Giovanni de' Medici defined the duties of cavalry as follows: to protect, to forage, to observe, to collect intelligence, and to keep the enemy in suspense.[24] No mention is made of charging.

Blaise de Monluc (1502-1577), Marshal of France, though he in no way despised the new firearms, said of the arquebus that it was "the devil's invention to make us murder one another." In this there was a certain amount of truth, for it did place an easy means of killing into the hands of the common people. Cervantes (1547-1616) was not far wrong when he wrote: "The devilish invention of artillery" enables a "base cowardly hand to take the life of the bravest gentleman . . . A chance bullet, coming nobody knows how or from whence, fired perchance by one that fled affrighted at the very flash of his villainous piece, may in a moment put a period to the vastest designs . . ."[25]

Ariosto (1474-1533) was even more outspoken in saying "O! curs'd device! base implement of death!"[26] While Milton also assigned the invention of artillery to the devil, and Shakespeare made Hotspur say: "That villainous saltpeter should be digg'd out of the bowels of the harmless earth, which many a good tall fellow had destroy'd so cowardly..."[27]

Though Thomas Fuller (1608-1661), divine and historian, in his "Worthies of England" considered that firearms had reduced casualties on the battlefield and though, over two centuries later, Lecky was of opinion that "gunpowder and military machinery have rendered the triumph of barbarism impossible,"[28] could they have witnessed the holocausts of the twentieth century they might have changed their views to those held by Ariosto, Milton, and Cervantes.

TECHNICAL opposition was also forthcoming, mainly in England, militarily the most conservative of all countries. There, so late as 1590, Sir John Smyth, in his "Certain Discourses Concerning the Formes and Effects of Diuers Sorts of Weapons," etc., still championed the longbow and was challenged by Humphrey Barwyck, who pointed out that, when in the service of the King of France, he had commended that weapon. The answer he received was: "Non, non, Anglois, vostre cause est bien salle, car dieu nous à donnés moyen de vous encountrer aprés un autre sorte que en temps passé . . ."[28] Really there was no more to be said, and, by an order of the Privy Council, the longbow was finally abolished in 1595.

Thus, by ousting an old system of warfare, gunpowder created a new system of peace. So it came about that in the sixteenth century it revolutionized not only the method of fighting but also the way of living and, in consequence, civilization itself. In fact, it established an outlook on things in general as different from the outlook of the Medieval Age as its outlook differed from that of the Classical. Therefore, with the advent of firearms we do not merely turn over another page in human history; instead we open a new volume, the title of which is "The Will to Power."

In it the first notable development is the centralization of power in the hands of the king. In feudal times, as we have seen, power was distributed among the nobles; now it becomes concentrated in the monarchy. The cost of artillery and the expenses entailed in equipping large numbers of arquebusiers were too great to be borne by any individual and in consequence were met by the state. Further, this concentration of power in secular hands raised the monarchy above the Church; for war, becoming a political instrument, ceased to be a moral trial.

It is during the sixteenth century that we see the rise of standing armies, the development of competitive armaments, and the introduction of the balance of power as a policy. Military service ceased to be the perquisite of a class and became a state profession. The development of mass fighting, if not of mass armies, was a characteristic of this age. If Machiavelli was not the first in modern times to suggest conscription, he, nevertheless, "composed the decisive memoranda on the basis of which was promulgated the Ordinanza (1506); *i.e.*, the law which established obligatory military service [in Tuscany] for all men between 18 and 30."[29]

Upon England's development as a naval power the influence of gunpowder was decisive. As the Wars of the Roses had eliminated the little of feudalism that still remained within her borders long before it had been swept away on the Continent she was better placed than any of her greater neighbors to forestall the approaching armament-revolution, as later on, in the eighteenth century, she forestalled the industrial revolution. Her rise as a naval power was due as much to gunpowder as her rise to world economic dominion in the nineteenth century was due to coal.

This portentous event, which for 350 years was to make her the dominant sea power in the world, is traceable first to Henry VII's (1485-1509) interest in his new ships the Regent and the Sovereign, and secondly to his son, Henry VIII (1509-1547), who was the first prince to grasp that in the rough northern waters oars must give way to sails and boarding to broadside fire. Thus it came about that, between 1520 and 1530, gun foundries in England were placed on a permanent footing in order to provide cannon for his great ships, such as the Great Harry and the Henry Grace à Dieu. Financially he was well placed to meet the cost, for the plunder of the Church enabled him to spend on a scale which had been impossible for his predecessors as it was for his successors without aid of grants from Parliament.

The Great Harry carried four "great cannon" (60-pounders) and a number of "demicannon" (32-pounders) as well as smaller pieces. The tendency was more and more to make the "great ship" an off-fighting instead of a boarding vessel. "This idea," writes Sir Charles Oman, "of making the warship a machine destined to operate by force of gunnery rather than a fort with a garrison of soldiers who were to board the enemy in close combat, was a cardinal change in naval psychology."[30]

In the hands of the Elizabethan seamen the cannon became the chief instrument of battle. "The gun was the weapon on which the English seamen had learned to rely. It was the gun, plied with rapidity, just out of pistol shot of his lofty ships, which in the year 1588 harassed and put to confusion the Spaniard, the haughty fighter who still maintained a quixotic contempt for the use of cannon and esteemed artillery 'an ignoble arm.' "[31]

Describing the action against the Spanish Armada on July 23rd, Lord Howard of Effingham wrote: "This fight was very nobly continued from morning until evening, the Lord Admiral [himself] being always in the hottest of the encounter . . . there was never seen a more terrible value of great shot . . . for although the musketeers and harquebusiers of crock [swivel] were then infinite, yet could they not be discerned nor heard for the great ordnance came so thick that a man would have judged it to have been a hot skirmish of small shot, being all the fight long within half musket shot of the enemy."[32]

THESE tactics are so well described by Sir Walter Raleigh (1552-1618) that they are worth quoting in full:

"Certainly, he that will happily perform a fight at sea must believe that there is more belonging to a good man-of-war upon the waters than great daring and must know that there is a great deal of difference between fighting loose or at large and grappling. To clap ships together without consideration belongs rather to a madman than to a man of war; for by such an ignorant bravery was Peter Strossi lost at the Azores when he fought against the Marquis of Santa Cruz [Battle of Terceira, 1583].

"In the like sort had the Lord Charles Howard, Admiral of England, been lost in the year 1588 if he had not been better advised than a great many malignant fools were that found fault with his demeanor. The Spaniards had an army aboard them and he had none; they had more ships than he had and of higher building and charging; so that, had he entangled himself with those great and powerful vessels, he had greatly endangered this Kingdom of England. For twenty men upon the defenses are equal to a hundred that board and enter; whereas then, contrariwise, the Spaniards had a hundred for twenty of ours, to defend themselves with-

out. But our admiral knew his advantage and held it; which had he not done, he had not been worthy to have held his head."[33]

That he was worthy led to astonishing results, for the defeat of the Spanish Armada opened North America to English colonization, which, in turn, founded the United States.

CHANGING the secular world, gunpowder also changed the religious, and, by enabling Christendom to spread its faith, it revived the spirit of the Crusades and led to imperialism. Before its discovery, writes Max Jähns in his "Geschichte der Kriegswissenschaften," "both the Indies were in the jaws of hellish Satan and in the very darkest obscurity, more like cattle or wild beasts in custom and belief than like reasonable creatures of the great God. Gunnery has been the only means by which the command of Christ could be performed (*Luke* 14, 23: 'Compel them to come in, that my house may be filled')."[34]

Gunpowder and the horse enabled the Conquistadores, notably Cortés and Pizzaro, not only to conquer the Americas as if by magic but to change the whole trend of aboriginal civilization. Greater distances could be traveled, tribal habitats were revolutionized, tribal equilibrium was upset, and tribal warfare became constant and more destructive. Much the same would seem to have taken place on the introduction of the horse and sword into Europe during the second millennium B.C.

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Yet another change must be mentioned, and possibly the most important of all—the influence of cannon on industry. First, it increased the consumption of iron, which increased mining. Secondly, it increased cost, compelling the rulers of Europe to have resource to the financiers, such as the Fuggers, and so fostered capitalism. On this question Lewis Mumford writes: "As security for the loan, the lender took over the royal mines. The development of the mines themselves then became a respectable avenue of financial enterprise, with returns that compared favorably with the usurious and generally unpayable interest. Spurred by the unpaid notes, the rulers were in turn driven to new conquests or to the exploitation of remote territories, and so the cycle began over again."[36]

In England, in Sussex and Kent, cannon foundries sprang up all over the Wealden country and so depleted the forests that in Elizabeth's reign legislation was required to prevent the charcoal burners from robbing the shipwright of his timber. Further, the export of English cannon became an exceedingly lucrative trade.

As Mumford points out, "the gun was the starting point of a new type of power machine: it was, mechanically speaking, a one-cylinder internal-combustion engine . . ." Because of it, heavy fortifications were developed, and road building, canal building, and bridge building became necessary adjuncts of warfare.[37]

These many changes, stimulated as they were by the influx of bullion from the New World which gunpowder was then conquering, were rapidly establishing a new social myth, neither religious nor military, but instead economic. Luther (1483-1546) inveighed against the monopolists and usurers quite as much as against the Pope; whereas Calvin (1509-1564) accepted both. In fact the whole Western World was at quarrel within itself. The devil had been unchained, and his agents were legion, for the disbandment of Henry II's army after the Peace of Le Cateau-Cambrésis had thrown tens of thousands of soldiers out of employment. These men were ready at hand for the religious war which broke out in France in 1562. Thus a new period of conflict opened which, with a few breaks, was to last until the Peace of Westphalia in 1648. Ideologically it was a period of total war which was unequaled in atrocities since the days of the Arian Schism.[38]

Politically, much may be learned from this long conflict, above all that when ideas instead of things are fought for, each party ascribes *all* virtue to itself and imputes *all* guilt to its adversary. In the end this means that ideological wars are largely fought in vain, because ideas cannot be killed by bullets or even changed if fervently held. Militarily, little is to be learned from the French Wars of Religion (1562-1598). And not much either from the revolt of the Netherlands (1568-1607), except that, during the struggle with Spain, Maurice of Nassau (1567-1625) proved himself to be a master of siegecraft and a military organizer of vision. It is not until we come to the Thirty Years' War (1618-1648) that, in the technique and tactics of Gustavus Adolphus (1594-1632), we find a noticeable advance in armament and firepower.

Reviewing military organization as it then was, Gustavus saw that the day of the national army was dawning and that the dominant weapon was the musket. Therefore he decreased the number of pikemen, shortened their pikes from sixteen to eleven feet, lightened their armor, and combined them with the musketeers in companies six files deep. He lightened the musket in order to dispense with the crutch or rest, reduced its caliber, substituted the wheel lock for the matchlock, and adopted the paper cartridge.

Of cavalry he employed two types, cuirassiers and dragoons. The first were partially armored, and the second were mounted infantry. The cuirassiers were formed into squadrons of three instead of ten ranks deep, and were trained to charge with the sword at the gallop instead of the trot, using their pistols only in the melee.

IN spite of the excellence of his infantry and cavalry, it was on the power of his artillery that his great battles of Breitenfeld (1631) and Lützen (1632) were founded. He was the first to gauge the true value of the field gun. In order to render this weapon mobile, he cut down its length, lightened its carriage, and reduced the number of calibers. He adopted three main types—siege, field, and regimental. The first two consisted of 24-, 12-, and 6-pounders—the siege cannon weighing 60, 30, and 15 hundredweight, and the field 27, 18, and 12 hundredweight. The regimental cannon were 4-pounder pieces weighing 5 hundredweight. There were 2 to a regiment, and they were provided with fixed ammunition in wooden cases which enabled them to fire 8 rounds to every 6 shots of a musketeer. These regimental pieces replaced his famous leather guns[39] which he had used in his Polish campaign of 1628-1629. The projectiles normally fired were grape and canister for field and regimental guns and round shot for siege.

In this new army, which radically differed from the

WITH the discovery of gunpowder, a substance unknown to the ancients, we pass into the technological epoch of war, the hidden impulse of which is the elimination of the human element both physically and morally, intellect alone remaining. It is the great inventions more so than the great men which disturb and accelerate the process of society.

Spanish model, we see the pattern which, with one important difference, was progressively followed in military organization until the end of the nineteenth century. This difference was the substitution of the bayonet for the pike, and this new weapon, coupled with the flintlock musket, made infantry supreme.

THE flintlock, or fusil, appears to have been invented about 1635. It was less expensive than the wheel lock and less cumbersome than the matchlock.[40] In 1646, General Monk recommended it for picked shots, and between then and the end of the century it came into general use. In 1658, at the Battle of the Dunes, of the 3,000 English musketeers in Turenne's army, 400 were armed with the flintlock.

The first mention of the bayonet[41] is made by the elder Seigneur de Puységur, a native of Bayonne, in his Memoirs, published in 1747. In them he informs us that at Ypres, in 1647, his musketeers fixed daggers into the muzzles of their muskets.[42] This particular weapon became known as the plug bayonet. In 1671 it was issued to French Fusilier regiments and in 1685 to the English Royal Fusiliers. How unsatisfactory it was, was clearly demonstrated at the Battle of Killiecrankie (1689), where Mackay's infantry, having fixed bayonets, were unable to fire and in consequence were routed by Dundee's Highlanders.

Shortly after this defeat, Mackay devised a socket bayonet which could be fastened to the muzzle of a musket by means of two rings.[43] It was not a new invention because the younger Puységur mentions ring bayonets in 1678.

Soon after the Peace of Ryswick (1697) the English and Germans abolished the pike and adopted the socket bayonet, as also did the French in 1703.[44] This change revolutionized infantry tactics. It reduced infantry from two types to one and simplified fighting. It also enabled infantry to reload under cover of their bayonets, to face cavalry, and to protect themselves in wet and windy weather when firing was restricted. Colonel Hime goes so far as to say: "The introduction of the bayonet marks the end of medieval and the beginning of modern war . . . Tactics were revolutionized by a dagger some twelve inches long . . ."[45] I should prefer to say it ended the first part of the gunpowder age by wedding the medieval to it, for the spear was now mated with the musket.

This radical change in armament coincided with as radical a change in the outlook on war itself brought about by the realization that unless the horrors of war could be restricted by rules, as the crimes of peace are by law, society must founder. The general result was that, whereas in medieval times honor existed between feudal knights and foot soldiers took little part in battle, now honor was established between armies led by aristocrats, and the common folk were excluded from the fray. During the greater part of the eighteenth century, wars were looked upon as royal games in which highly drilled soldiers were the counters or pieces, and, because they were costly to maintain, armies remained small, and bloody encounters were generally avoided. The masses of the people were excluded from the struggle, and depot supply replaced pillage and foraging. Further, and what was the wisest change of all, the rules of the game laid down that "neither justice nor right nor any of the great passions that move a people should be mixed up with wars,"[44] because the bullet is no answer to an idea, and should it be considered an answer, then there could be no end to a war other than total collapse or exhaustion.

Between 1703 and the outbreak of the War of American Independence in 1775, when ideological war was reintroduced, though the sole improvement in infantry arms was the substitution of an iron for the wooden ramrod by Leopold of Anhalt Dessau in 1740, vast strides forward were made in artillery. Technically, the most notable suggestions were those of an Englishman, Benjamin Robins, in his book "New Principles of Gunnery," published in 1742. Though he advocated the breech-loading rifled gun and breech-loading musket, which were a hundred years before their day, his most noted invention was the ballistic pendulum. This instrument enabled the gunner to measure the velocity of his projectile, and, in consequence, to improve his powder.

Only during the last quarter of the eighteenth century do we find new projectiles being devised; namely, Mercier's operative gun shell during the siege of Gibraltar (1779-1783)—a 5.5-inch mortar shell with short fuze fired from a 24-pounder gun—and Lieut. Henry Shrapnel's "spherical case" as he called it, but better known as shrapnel shell. The one was destined to render the wooden battleship obsolete and the other to revolutionize battle tactics. Though Shrapnel invented his shell in 1784, it was not adopted by the British Ordnance Committee until 1803.

Tactically, the most noted innovation was the introduction of horse artillery by Frederick the Great (1740-1786) in 1759. And only second to this was the extensive use he made of field howitzers, a weapon first employed by the Dutch at Nerwinden in 1693.

THE greatest progress was, however, made in France under the direction of Gribeauval (1715-1789) who, in 1776, was appointed Inspector General of Artillery. Though he was unable to persuade the King to create horse artillery,[47] he introduced limber boxes and reorganized French artillery from top to bottom. His field artillery was restricted to 4-pounders as regimental guns; 8- and 12-pounders, and 6-inch howitzers as reserve, or what would now be called divisional guns; and for garrison and siege, 12- and 16-pounders, and 8-inch, 10-inch, and 12-inch mortars. All carriages were constructed on a uniform model, all parts being interchangeable as far as it was possible. Horses were harnessed in pairs instead of in file.

Two other effects remain to be noted. The first is that the increasing use of artillery involved an increase in the number of horses and wagons and, consequently, the lengthening of columns on the march. This in turn raised the problem of their protection which brought about the formation of light infantry and light cavalry units.[48]

The second effect was the rise in the cost of armies, due mainly to the increase in artillery and the ever-increasing demands on industry for standardized arms and equipment which, as Mumford points out, hastened factory organization.[49] Military demands fostered mass production, which, in turn, stimulated the growth of armies and the advance of capitalism. The quality idea upon which eighteenth-century

fighting power was based, was, in the last part of that century, steadily giving way to the quantity idea, and at the very moment when steam power—quantity energy—was being introduced. Like gunpowder, steam was destined to revolutionize warfare and by doing so to open a new chapter in the history of the will to power, called "The Nation in Arms." (*To be continued.*)

YET another change must be mentioned, and possibly the most important of all—the influence of cannon on industry. First, it increased the consumption of iron, which increased mining. Secondly, it increased cost, compelling the rulers of Europe to have recourse to the financiers, such as the Fuggers, and so fostered capitalism.

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[1] "History of European Morals," William Edward Hartpole Lecky, 1902, Vol. I, p. 126.

[2] "Sartor Resartus," Thomas Carlyle, Chap. VIII.

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[4] "Discourses," Chap. XL, Bk. III.

[5] On this question Sir Charles Oman writes: "There was some protest against it even among the French nobility; but the feeling of the man in the street was undoubtedly expressed by the old swashbuckler Montluc when he wrote: 'Christian princes on the other side made much ado about our master calling in the Turk to his aid. But against one's enemy one may make an arrow of any sort of wood. For my own part, I would call up all the devils of hell to help me break my enemy's head, when he is trying to break mine. I would do it cheerfully, and then may God pardon me'" ("A History of the Art of War in the Sixteenth Century," 1937, pp. 10-11).

[6] "The Origin of Artillery," Lieut. Col. Henry W. L. Hime, 1915, pp. 112-113.

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[12] *Ibid.*, Vol. II, p. 222.

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[15] Two stone balls, forty-six inches in diameter, still exist in Constantinople. Machines throwing much larger balls were in use just before the invention of great cannon.

[16] See "Le Siège la Prise et le Sac de Constantinople par les Turcs en 1453," Gustave Schlumberger, p. ii.

[17] "A History of the Art of War," Vol. II, p. 226.

[18] *Ibid.*, Vol. II, p. 227.

[19] "The Art of War in Italy, 1494-1529," F. L. Taylor, 1921, p. 90.

[20] For a full account of this extremely interesting battle, see Taylor, Appendix A.

[21] "The Prince," Everyman's Library, Chap. XII, p. 98.

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[23] "The Art of War in Italy, 1494-1529," F. L. Taylor, p. 61.

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[25] "Don Quixote," Pt. 1, Bk. II, Chap. 11.

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[31] "The Evolution of Naval Armament," Frederick Leslie Robertson, 1921, p. 77.

[32] State Papers Relating to the Defeat of the Spanish Armada, edited by John Knox Laughton, Vol. I, p. 156.

[33] "Historie of the World," Sir Walter Raleigh, 1736, Vol. II, p. 565.

[34] Quoted by Alfred Vagts in "A History of Militarism," 1938, pp. 44-45.

[35] In 1890 "The power of the Masai was waning, and a new power, that of the Akikuyu, seemed in the ascendant; for a once peaceful agricultural tribe had become a warring one, losing its native culture in exchange for a pastoral and foreign one. It is unquestionable that in this change the borrowed assegai proved a main and impelling factor" (Walter Dyk, quoted by Quincey Wright in "A Study of War," Vol. I, p. 86).

[36] "Technics and Civilization," 1934, p. 76.

[37] *Ibid.*, p. 88.

[38] See Gibbon's remarks in "The Decline and Fall of the Roman Empire," Vol. II, Chap. XXI.

[39] They were invented by Colonel Wurmbrant and consisted of a copper tube bound with iron rings and rope and covered with leather.

[40] The flintlock was easier to aim as its butt could be brought to the shoulder, whereas that of the matchlock was placed against the chest six inches below the chin. Its time in loading was half that of the matchlock—by 1700 at least one round a minute could be fired. In presence of the enemy the match had to be kept burning, which at nighttime gave positions away.

[41] Probably derived from the town of Bayonne, where short daggers called "bayonettes" first made their appearance.

[42] An earlier claim is 1643. (See "Gaya's Traité des Armes 1678," edited by Charles ffoulkes, 1911, p. xiii.)

[43] Makay's "Memoirs of the Scottish War," 1833, p. 52.

[44] This bayonet remained in the British service until 1805, when Maj. Gen. Sir John Moore introduced the spring-clip bayonet.

[45] Stray Military Papers, 1897, p. 23.

[46] "Peace and War," Guglielmo Ferrero, 1933, p. 7.

[47] Adopted by the French and Swedes in 1791 and the English in 1793.

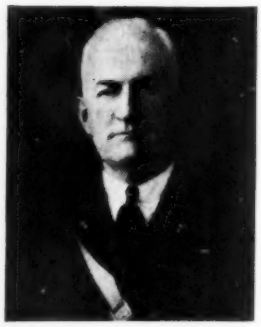
[48] For light infantry during this period see my "British Light Infantry in the Eighteenth Century," 1925.

[49] "Technics and Civilization," p. 90.

Ordnance Roll of Honor

THE two officers listed below have been awarded the Distinguished Service Medal for service as outlined in the accompanying citations:

MAJ. GEN. JAMES H. BURNS, Washington, D. C.—(*Oak Leaf Cluster*) "As executive of the Office of the Assistant Secretary of War, later the Office of the Under Secretary of War, and subsequently as a member of the Munitions Assignments Board, he foresaw the impact upon the United States of possible failure of diplomatic negotiations of other nations with the Axis powers. By the exercise of unusual qualities of leadership in which he displayed farsightedness and perception, he quickly foresaw the magnitude of the task of transforming the Nation from peacetime production to the tempo of producing the volume and intricate military defense requirements.



Maj. Gen. James H. Burns

"By utilizing his vast knowledge of complications which arise from problems in the transition from production for peace to production for war, he outlined the major legislation necessary and was instrumental in obtaining the early adoption of many of the statutes required for the later expansion of the war production program. Displaying executive leadership to an exceptional degree, he grasped the interminable problems of production and supply and was responsible in a great measure for the high order of preparedness which the industrial mobilization program attained in successive critical stages in the security of the Nation.

Maj. Gen. R. L. Maxwell

"Repeatedly, under stress, while in a position of great responsibility he demonstrated ability to strip a problem to its essentials and make clear-cut, quick decisive recommendations to higher authority. During the formative period of the Lend-Lease program, he developed methods for establishing proper records and accounting for supplies furnished to friendly foreign nations, the support of which was deemed essential to the defense of the United States. Later, as a member of the Munitions Assignments Board, he displayed the highest qualities of tact and acted with force and vision in a manner that contributed in a superior degree to the success of the Nation's industrial mobilization for wartime needs and the flow of supplies of Lend-Lease nations." (General Burns was awarded the Distinguished Service Medal in 1922 for his outstanding services in securing production of explosives and ammunition to meet the needs of America's armed forces in the first World War, 1917-1918.)

MAJ. GEN. RUSSELL L. MAXWELL, Fort Myer, Va.—"As chief of the U. S. Military North African Mission and later commanding general, U. S. Army Forces in the Middle East, from September 1941, to November 1942, he commanded the U. S. Army troops in the Middle East and represented the War Department and its many undertakings in that area pertaining to the war effort. His extensive and varied experience, his energy and his foresight enabled him to meet a multitude of problems under most unusual and adverse conditions and to accomplish the missions assigned him with conspicuous success."

THE following officers and men have been awarded the Legion of Merit for service as outlined below:

COL. LEO A. CODD, Washington, D. C.—"For service in connection with public relations and historical activities of the Ordnance Department from June 15, 1942, to September 8, 1944. As executive assistant to the Chief of Ordnance, he distinguished himself by the outstanding manner in which he planned and executed several important innovations in the press, radio, and visual education fields which resulted in better preventive maintenance of Ordnance equipment, increased production, and a better understanding of the service's contribution to the war effort by the American people. As historical officer of the Ordnance Department, his contribution to future national preparedness was particularly noteworthy."

Col. Leo A. Codd

COL. THOMAS F. BROWN, New York, N. Y.—"For service as assistant director of safety and chief of the Security Section, Safety and Security Branch, Office of the Chief of Ordnance, during the period August 29, 1942, to November 7, 1943. Through his administrative and executive ability, tact, initiative, and technical efficiency, he effectively contributed to the war effort by establishing such security within and without plants, camps, and stations where explosives hazards existed that no major disasters occurred which might have seriously interrupted production during the critical period of his incumbency. He also reduced the plant guard forces without loss of protection against external and internal interference, resulting in substantial savings to the Government."

Col. Thomas F. Brown

COL. CARROLL H. DEITRICK, Washington, D. C.—"For service as chief, Levels and Credits Section, Policy Branch, Supply Division, G-4, War Department General Staff, and as chief, Policy Branch, Supply Division,

G-4, War Department General Staff, between November 18, 1943, and October 2, 1944. His foresight, judgment, and keen analytical ability greatly contributed to the successful determination of proper supply levels in both theaters and the zone of interior as well as a proper fixing of days of supply, replacement factors, and the establishment of theater credits for items in short supply. He effectively supervised and coördinated policy matters relating to the determination, interpretation and control of distribution, storage, and issue of equipment and supplies throughout the Army. In implementing the recommendations of the Joint Army-Navy Ammunition Board he demonstrated a thorough grasp of the board's problems and did much to further its success. His ceaseless efforts in all matters relating to disposition of captured matériel, settlement of claims, and property accountability, as well as the acquisition and disposition of land and facilities located thereon, resulted in invaluable service to the War Department General Staff and to the United States Army."

Col. C. H. Deitrick

COL. HENRY R. WESTPHALINGER, Washington, D. C.—"For service from June 1943, to September 1944. As chief of the Programs Branch, Requirements Division, Headquarters Army Service Forces, Washington, D. C., and subsequently as deputy director of that division, he displayed a high quality of leadership and executive ability and exhibited unusual professional attainments, superior judgment, foresight, and devotion to duty in the scaling of requirements planning in the Army supply program to match operational and strategic needs of the armed forces. His shrewd direction of difficult planning necessary to balance the determination of over-all requirements of combat essentials against the capacities and capabilities of industry to the end that overproduction was held to a minimum, was a vital contribution not only to the success of our armies in the field but also to our national economy as well."

Col. H. R. Westphalinger

LIEUT. COL. JOHN F. MCCARTHY (then Major), Tacoma, Wash.—"For exceptionally meritorious conduct in the performance of outstanding services at Oro Bay and Milne Bay, New Guinea, from December 29, 1942, to October 7, 1943."

CAPT. JOHN F. O'LOUGHLIN, Winnetka, Ill.—"For services from October 1942, to April 1943. Charged with the maintenance and operation of automotive matériel during the cold-weather tests conducted by the Ordnance Proving Center, Winter Detachment, at Shiloh Camp, Manitoba, Canada, he, with ability and rare energy, rapidly organized and trained his section efficiently to handle the diversified equipment, consisting of one or more pieces of each type and size of every important item of ordnance automotive development and procurement. He successfully conducted all trials and tests, despite temperatures as low as 45 degrees below zero, Fahrenheit, and winds of blizzard intensity. Included in the successful tests was that of a medium tank equipped with a special engine installation developed by him, which has proved to be practical both in arctic and desert operation. He also developed, during the tests, a vehicle mounting auxiliary starting aids which proved itself invaluable in starting engines where the most difficulty was encountered."

Lieut. E. A. Savage

Capt. J. F. O'Loughlin

M. SGT. CHARLES L. CARLSON, Axtell, Nebr.—"For exceptionally meritorious conduct in the performance of outstanding service from July 1 to November 30, 1943, in the Persian Gulf Command."

M. SGT. EDWARD A. DUVAL, Groton, Mass.—"For services from June 5, 1942, to January 3, 1944, at the Persian Gulf Command. Upon the arrival of an Ordnance medium automotive-maintenance company at Iran, he installed a water system, concrete floors, building coolers, and contributed in many ways to the comforts and living conditions in the newly established camp, much of which was accomplished by the utilization of improvised materials. In the early days of the checkup station, he set up procedures to be followed for specialized shops and inspections. . . ."

THE officer listed below, has been awarded the Silver Star for service as outlined in the accompanying citation:

COL. ARTHUR H. LUSE, Franklin, Pa.—"The courage, coolness, and complete disregard for personal safety displayed by him in action in Normandy, France, June 22, 1944, reflected the highest credit upon himself and the armed forces of the United States."

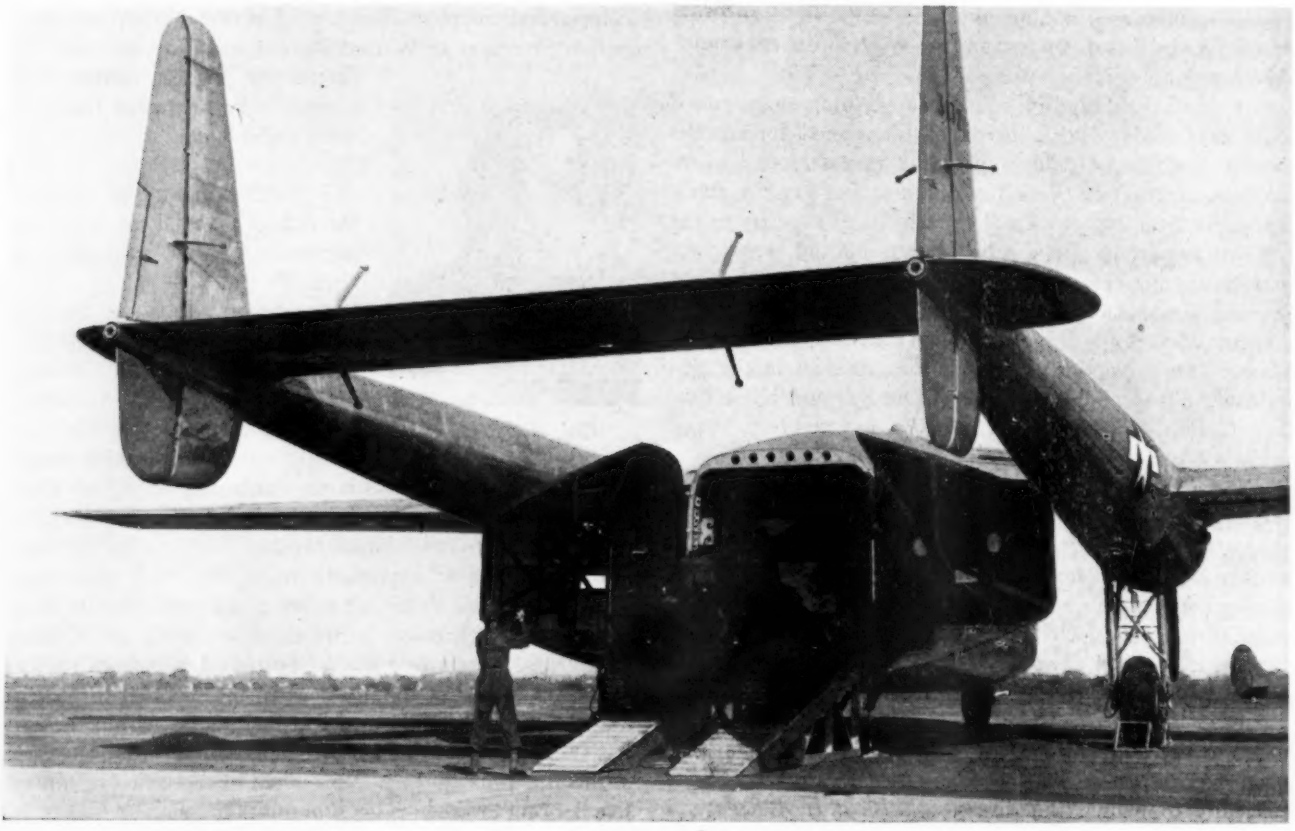
Col. A. H. Luse

THE following officer received the Soldier's Medal for service as outlined in the accompanying citation:

1ST LIEUT. ERIC A. SAVAGE, Silver Spring, Md.—"On November 2, 1943, at Raritan Arsenal, Metuchen, N. J., during the loading and blocking of freight cars loaded with incendiary bombs, one of the boxes containing thirty of these 4-pound bombs exploded in a steel car. The fire incident thereto spread to other boxes, causing them to explode. During these series of explosions, numerous hasty exits were necessary to avoid flying white-hot metal and to secure fresh air to combat chemical fumes in the burning car. During these trips, he removed several burning boxes from the car before the arrival of the fire department, in order to prevent the spreading of flames to the 18,000 bombs within the car; this without regard for his own safety. The prompt control of this fire and explosion . . . resulted in the saving of ninety-five per cent of the burning ammunition. . ."

The C-82 — New Aërial Freighter

The Fairchild C-82 cargo airplane, shown in the Air Forces photo above, is the first warplane designed specifically to carry military cargo. Weighing about 50,000 pounds, it has a wingspan of 106 feet and a range exceeding 3,500 miles. The Ordnance photo below shows how heavy matériel, such as the M22 air-borne tank, is unloaded from the rear.



Ordnance at Anzio

Signal Corps

Lieut. Col. John G. Detwiler

When Ordnancemen hit the beach at Anzio, Italy, with the assault wave on January 22, 1944, it was expected that the Fifth Army forces, then besieging Cassino, would break through that bastion in at least two weeks and relieve the beachhead. Four months later Anzio was still a beachhead—and the men of Ordnance were still on the job. What a swell job they did is graphically told in this "blow-by-blow" story of heroism and ingenuity.

NOW that the Fifth Army's operations on the Anzio beachhead have been successfully completed, the story of Ordnance's support of that operation can be told. The individual deeds of valor and meritorious service under extremely adverse conditions are a story in themselves. This short history of events must of necessity deal only with the peculiar conditions and operating problems which confronted Fifth Army Ordnance service at the beachhead. Suffice it to say that War Department records will show a large number of individual awards to Ordnance personnel at Anzio and that all Ordnance units participating in the operation received Fifth Army plaques for superior service rendered. Before considering the task of Ordnance at Anzio in detail it will be helpful to get a "bird's-eye view" of the whole action.

The Anzio operation called for landings in force by United States and British elements of the American Fifth Army. It was planned to force an entry into Rome and cut off the German divisions fighting on the main Fifth Army front running through Cassino to the south. Circumstances prevented the completion of this plan, and the operation developed into one of holding and consolidating the ground won on the first landings. The U.S. VI Corps executed the operation.

The 45th Ordnance Battalion was nominated to plan and operate the Ordnance service for the beachhead, and as such was attached to VI Corps on January 4, 1944. Advanced elements of this battalion sailed with the assault forces and landed on January 22nd. The battalion reverted to army control on February 6th. In addition to the maintenance and supply function, the battalion was responsible for the ammunition supply on the beachhead until the arrival of the 87th Ordnance Battalion headquarters on March 11, 1944. A small detachment of ammunition officers and men was attached to the 45th Battalion to operate the ammunition companies prior to March 11, 1944.

The setup of Fifth Army Ordnance into a "vertical" organization with all administrative work in one group—the 2660th Ordnance Group (Provisional); all third-echelon forward Ordnance service in another group, the 2630th Ordnance Group (Provisional); all supply, evacuation, and fourth-echelon service under a third group, the 6694th Ordnance Base Group (Provisional); and all ammunition under one battalion, the 62nd Ordnance Battalion—proved sufficiently flexible to enable a change-over to "horizontal" lines when the beachhead developed. A beachhead Ordnance officer, acting as deputy for the army Ordnance officer, had control of all Ordnance operations including ammunition and thus had a parallel setup to the army Ordnance organization operating behind the Fifth Army main front.

All elements of Ordnance service were operative at Anzio, and the senior Ordnance officer acting as a deputy Fifth Army Ordnance officer served on the special staff set up by the Fifth Army at Anzio. Upon the joining up of the main Fifth Army with the beachhead forces on May 25,

Colonel Detwiler, formerly executive officer, Ordnance Section, Allied Force Headquarters, North African Theater of Operations, is now with the 53rd Ordnance Group.

1944, the beachhead Ordnance organization reverted instantly to the "vertical" organization which has been tried and proved to the satisfaction of Ordnance customers; namely, the combat troops of the Fifth Army.

Readers who have participated in similar operations may consider it an oversight to neglect the harrowing details of the planning and preparation phases of the Anzio operation which involved a 30-day period prior to the actual landing on January 22, 1944. It is the writer's considered opinion, based on the observation of four such preparations for amphibious operations, that excitement and confusion and the ever-recurring problem of too much to do in too short a time will always be a part of this type of military operation. As usual, however, the assault vehicles were waterproofed and loaded; the follow-up vehicles were serviced and repaired; the ammunition and spare parts were packed and stowed, and the troops were loaded on schedule.

It should be pointed out that on every one's mind as they prepared to step ashore on the beaches at Anzio was the over-all Fifth Army plan to join up the southern Fifth Army forces besieging Cassino with the beachhead forces in a matter of ten days or at the most two weeks after D-day. This plan was clear to even the private in the ranks because many vehicles from each organization as well as considerable personnel had to be left behind at the Naples staging area with the intention of bringing them overland to Rome a week or two after D-day. Neither the American staffs nor the German staffs in Italy could have anticipated the establishment of a more or less "permanent beachhead."

THE United States VI Corps planned and executed the Anzio operation and the 45th Ordnance Battalion, reënforced by a small group of ammunition officers and enlisted men, was assigned to support the Corps. The VI Corps plan called for an advance Ordnance detachment to accompany the assault wave. Attached to the 540th Engineer Shore Regiment, this Ordnance detachment consisted of two ammunition companies and a small number of maintenance personnel. Thus the first Ordnance troops to land at Anzio were the 66th Ordnance Ammunition Company personnel attached to the Engineer Shore Regiment, which landed fifty minutes after H-hour. The landings were almost unopposed, and little difficulty was encountered on the beaches.

The Corps ammunition officer immediately selected a site for the ammunition dump three miles east of Nettuno and the advance Ordnance detachment began unloading DUKWS by 0900 hours (H plus 7). The enemy had begun to react by this time, however, and within a half hour this ammunition dump was strafed by enemy aircraft and two Ordnancemen were wounded—the first of many Ordnance casualties in the Anzio operations.

Ordnance maintenance units landed at about 1100 hours (H plus 9), and the 45th Ordnance Battalion headquarters was immediately established and central wrecker service started to haul vehicles off the marshland near the beach. Communications were established and signs posted on the roads showing the location of Ordnance units. Sites for Ordnance Class II and IV dumps were selected and work begun to stock them from the stream of DUKWS moving over the beaches. Much of this back-breaking work might have been done by civilian labor except for the fact that the Germans had evacuated most of the local inhabitants approximately four months prior to the landing. In addition to the hard physical labor, the additional hazard of strafing and bombing by enemy aircraft was ever present, particularly in the early days of the landing.

On January 25th (D plus 3), the follow-up waves, including the majority of Ordnance personnel and vehicles, began to land. At about this time it became apparent that operations were not proceeding according to plans and the rear detachments of the beachhead Ordnance units which had been left in the Naples staging area eventually to arrive in Rome overland, were now hastily loaded on LST's and sent to join their parent organizations at Anzio. In addition, the maintenance support for the beachhead troops was brought into balance by sending two medium maintenance companies and an additional depot company to the beachhead.

FROM this point on, the story is one of Ordnance maintenance and supply conducted under extremely adverse conditions. All Ordnance installations were subjected to heavy and medium enemy artillery fire and severe air raids. It is certain that this is the first time that maintenance shops, depots, and dumps had to be operated under these conditions. Thus it is not surprising that a tabulation of Ordnance casualties for the first 2 months at Anzio shows 14 killed in action, 8 seriously wounded, 65 slightly wounded, and 5 injured.

No story of the beachhead is complete without a description of the enemy artillery activity as viewed from the receiving end. The heaviest enemy fire was received at night, although any hour of the day or night witnessed some "receipts." A great deal has been said about the noise of these projectiles in flight and in particular that granddaddy of all noises, the "Anzio Express." The wail of this 280-mm. projectile was a primary cause of the few cases of so-called "Anzio Anxiety" which developed. The terrific explosion of this projectile seemed to shake the ground of the entire beachhead, and the projectile itself must be seen to be believed, since it has curved splines from ogive to boattail instead of rotating bands to impart rotation in its travel through the gun barrel.

This and other similar enemy activity quickly drove the beachhead troops underground to the extent that everything possible, including offices, quarters, supplies, etc., were dug in deeply in the natural and man-made caves which abound in this part of Italy. Daylight working hours were shorter than is customary in normal Ordnance field operations since it was not good policy to remain above ground in the shop areas after the evening meal inasmuch as concentrated shelling and most severe air raids seemed to begin just before dusk.

ANOTHER interesting story of the long siege involves the extensive measures taken by the units on the beachhead to provide for adequate local defense. All Ordnance troops were prepared to execute any one or a combination of all three basic defense plans in case of a serious enemy breakthrough: Plan "A" called for the destruction of all vehicles and classified files; Plan "B" called for evacuation of vehicles and classified files; while Plan "C" called for organization of Ordnance troops into Infantry squads and platoons for actual combat. All plans were given several "dry runs" so that any could be executed with dispatch. Five units of fire for all weapons in the hands of Ordnance troops were kept in readiness by each unit.

In addition to all these precautions it was almost a nightly

Signal Corps

ORDNANCEMEN ASSEMBLING REPAIRED SMALL ARMS FOR REISSUE TO TROOPS

occurrence to double the guard, man all automatic weapons, tanks, etc., immediately upon being warned by Intelligence officers. By thus keeping awake a large number of Ordnance personnel for this extra duty, the enemy reduced somewhat the efficiency of the combat Ordnance service. All conditions considered, however, it is the author's estimate that the over-all production drop in the Ordnance shops and installations was not more than thirty per cent when compared with normal Fifth Army Ordnance operations.

A VERY significant Ordnance development brought about by unique circumstances existing at Anzio was the technique evolved by the Ordnance ammunition companies to fight the nightly fires in the ammunition dumps which were started by enemy aircraft and artillery. Since all the dumps were under direct observation and fire by medium and heavy artillery, it became routine procedure to fight many fires in these dumps each night. When an ammunition fire was started, the enemy shelled the fire area heavily to prevent fire-fighting activities or, if the fire was started by aërial bombs, the follow-up waves of enemy bombers would scatter antipersonnel bombs over the area for the same effect.

The evolution of the final ammunition-storage bunker is an interesting story in itself. Briefly, the first efforts consisted of bulldozing a pit three to five feet deep by approximately fifty feet long and then piling the ammunition in the pit. It was promptly discovered that rain filled the pits and would not drain off because of the soil condition existing. In an effort to correct the flooding, the Signal Corps coöperated in drilling three deep postholes in the bottom of the pits to provide drainage. This proved unsuccessful, again because of the soil. The bulldozers were then employed in making "L"-shaped dirt bunkers five to six feet high with the corner of the "L" toward the enemy artillery positions. The ammunition was stacked inside the "L" with a maximum of thirty tons per stack and thirty yards between stacks in a row.

M4 medium tanks were then equipped with Engineer bulldozer blades and located centrally in the dump areas. When a fire started, the drill consisted of running the tank with blade up to the burning stack and scattering the dirt from the bunkers over the top of the burning ammunition boxes. The tanks gave protection against enemy artillery, the heat of the fire, and the explosions within the fire itself. This combination proved highly successful, and no fire spread outside the 30-ton bunker in which it started, although several bunkers were involved in almost every fire. It should also be mentioned that hand shovels, armored half-tracks equipped with chemical fire extinguishers, and T2 track retrievers equipped with a bulldozer blade were likewise used by the Ordnance ammunition personnel fire-fighting teams.

Great personal heroism and devotion to duty were exhibited by the Ordnance ammunition companies during the entire beachhead operation. This is perhaps best illustrated by the fact that the average loss in more than one hundred ammunition fires was less than thirty tons per fire, although at the peak of operations there were approximately sixty thousand tons of Class V supplies stored on the beachhead. This tonnage of ammunition was largely held in seven Army ammunition supply points and, because of the hazard involved, an early decision was made to disperse the maximum amount of ammunition to the battery and gun positions. Approximately ten thousand tons were dispersed in this way, and the only disadvantage seems to have been in the increased effort necessary to clear up the many small dumps after the beachhead was liquidated.

OF vital importance to the maintenance task was the safe storage of the Class II and IV supplies which were at first placed in some large artillery school buildings on the edge of the town of Anzio. These buildings were arranged in a quadrangle and provided a fine artillery target for the enemy. A decision was reached to spread the Class II and IV supplies equally between two depots; namely, the original quadrangle buildings and the buildings of an Italian ammunition loading plant one mile south of Nettuno. These latter buildings were enclosed in large earth bunkers and except for the exposed roofs were extremely safe from enemy

action. Each standard nomenclature list group was split vertically, and half of the available items were put in each depot. This provided a safety factor, and with the arrival of a second depot company the man power was provided to operate the two identical Class II and IV depots efficiently and effectively.

Of interest in this connection was the plan evolved whereby each job in both depots was handled by two men, one from each of the two depot companies involved. It was envisioned that when the push on Rome developed, one depot company could load up its sixteen vans and follow the push, while the two beachhead depots would be left in the hands of the remaining company with no loss of efficiency, since the remaining company had a trained man on each job. This course of action proved wiser than having one company operate each depot independently. Although there were some critical shortages, in general the over-all stockage of maintenance spare parts in beachhead depots was the best experienced at any time by the Fifth Army.

THE American and British forces on the beachhead were augmented early in May by the arrival of another American Infantry division, making a total of three U. S. Infantry divisions at Anzio. Preparations were then begun for an attack from the beachhead to be coördinated with the frontal attack on the fortress of Cassino. The southern front D-day was May 11, 1944, and the jump-off from the beachhead was made on May 23rd.

The beachhead plan called for part of the forces on the right flank to join up with the attackers from the south, somewhere south of Rome on Route No. 6. This actually took place near Valmontone on May 30, 1944. Another spearhead from the beachhead forces was directed north from Rome, which was entered on June 5, 1944. Prior to these dates, Fifth Army forces from the south made formal junction with the beachhead forces in the Pontine Marsh area south of the beachhead on May 25, 1944, thus formally ending the 4-month siege.

The Ordnance plan for supporting the jump-off from Anzio was routine except that a very large number of armored vehicles were processed through the third-echelon shops on the beachhead prior to May 23rd, and these were then sent to the Armored Division's vehicle pool instead of being held by the Ordnance third-echelon establishments for subsequent issue. This arrangement was considered advisable because of the speed of replacement made possible and also because of expected high losses due to enemy mine fields around the beachhead. By this arrangement the maintenance battalion of the Armored Division had a large stock of armored vehicles which had already received a complete inspection and tryout prior to D-day which could be issued instantly without reinspection or trial. As the attack developed, this policy paid great dividends as at one time in the early morning of May 23rd thirty medium tanks were halted on a mine field less than a quarter of a mile from the jump-off line. Immediate replacements were made by the Armored Division maintenance pool, and the thirty tanks were left on the mine field until nightfall when they were pulled back and all repaired.

Several Ordnance design and manufacturing projects contributed directly to the ultimate relief of the beachhead. One of these was a portable artillery observation tower which folded onto the bed of a GMC truck and could be extended forty-five feet above the ground by using the winch on the truck. This was designed and built in the Ordnance heavy-maintenance tank company on the beachhead to give American artillery a more advantageous observation post. The Germans were on the high ground and could see us, but we were on level ground and thus practically "blind." The project was received enthusiastically by VI Corps artillery.

Another project was the conversion of Italian farm tractors found on the beachhead into prime movers for towing bangalore torpedoes out into the German wire entanglements. These were set on a straight course and were driverless. The Infantry division concerned in this development was extremely ingenious in trying every possible means to crack the enemy's prepared positions. Another method was to pull Infantry "sleds" behind medium tanks, twelve sleds behind one tank, and each sled containing a soldier. The Army Ordnance fourth echelon designed and built 360 of these sleds in record time, and they were successfully used in the break-through. The production-line setup for the forming and welding of these sleds was worthy of the automotive industry's best traditions.

Other critical parts, such as rifle grenade adapters, were made by the thousands in fourth-echelon shops and were flown over the German lines to Anzio in time for the attack. Many of these projects are worthy of a story in themselves, but the point in mentioning some of the most outstanding is to show the close coöperation existing between using arms and Ordnance support in a tight situation. Each contributed to the successful conclusion of the operation.

WHILE it is not to be expected that a future beachhead landing operation will result in the establishment of a 4-month battlefield on the actual landing area, there were certain lessons in the Anzio operations which should be of definite value to those engaged in any similar future action. From an Ordnance command standpoint it proved essential to invest control and direction of all Ordnance activities in a senior Ordnance officer who dealt directly with corps and army headquarters for over-all plans and utilization of Ordnance personnel and facilities.

Continuous and detailed conferences between corps and army and the senior army Ordnance officer on the beachhead resulted in frictionless and fruitful operations. In effect, the Ordnance organization on the beachhead was a parallel to the Fifth Army Ordnance service behind the southern front and as such constituted a "horizontal" organization in direct contrast to the normal Fifth Army "vertical" organization. The flexibility of the normal organization was clearly proved by the success of the abnormal setup for the beachhead Ordnance service.

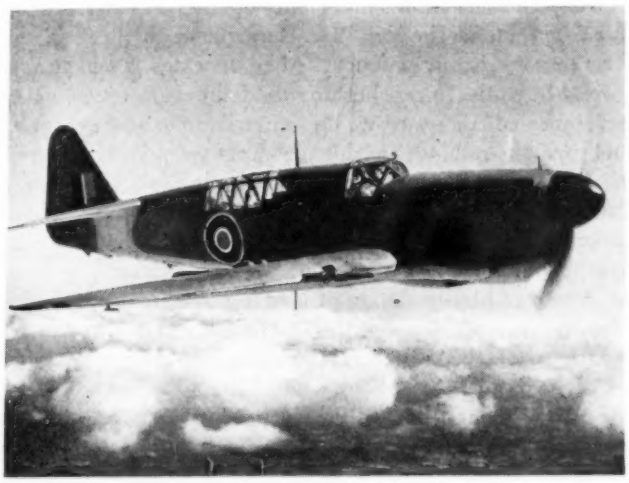
Important technical lessons on combat waterproofing and dewaterproofing, centralized Ordnance wrecker service, utilization of Ordnance personnel, Table of Equipment and Table of Organization changes, and similar matters are not of general interest but form a valuable part of the historical record of Ordnance operations at Anzio.

It is the expressed opinion of most Ordnance officers and men who served on the Anzio beachhead that Ordnance service and *esprit de corps* reached a new high which made the stay there the best tour of duty in the war up to that time. Conditions fostered the closest coöperation with all elements of the Army, and common dangers brought every one on the beachhead to the realization that an Army "team" is more important than any individual part of the team can possibly be. In a word, teamwork kept us on the beachhead.

Recent Aircraft Developments

Four 330-horsepower jet-assisted take-off units sweep this Grumman Avenger torpedo bomber into the air in less than half its normal run. Attached to the plane's fuselage, the jet units contain solid propellant which is ignited at take-off by electrical control (Navy photo).

The R-6 helicopter is an improved version of the original R-4. A small wheel protects the plexiglas nose and a paper-based cowling encloses the engine and rotor shaft. The cabin is made of glass fiber cloth, and the tail cone is covered with magnesium skin (Air Forces photo).



The Firefly, a heavily armed British fighter-reconnaissance plane, will operate with British carriers in the Pacific. It carries four 20-mm. cannon and a camera for vertical photography. It has folding wings and is powered by a 12-cylinder Rolls Royce engine (British photo).

The R-5 helicopter, big brother of the R-6, is powered by a Pratt & Whitney 5-cylinder, 450-horsepower, air-cooled engine. The fuselage is 40 feet long from nose to tail. Space is available for cameras, radio accessories, other equipment, and 4 litters (Air Forces photo).

The Bell P-59 Airacomet jet-propelled airplane is marked by the absence of propellers and by the two airscoops of its twin jet engines on either side of the fuselage. These engines operate on the gas-turbine principle, and give the plane great speed and climb (Air Forces photo).

The experimental Platt-LePage XR-1 helicopter is distinguished by its twin rotors at the end of streamlined pylons and the absence of a tail rotor, torque being neutralized by the opposite rotation of the rotors. The craft weighs approximately 4,800 pounds (Air Forces photo).

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JANUARY-FEBRUARY, 1945

Month by Month

Staff Announcements.—Col. Leo A. Codd, Ordnance Reserve, who has been on military leave since early in 1942, has resumed, at the request of the president of the Army Ordnance Association and with the approval of the Chief of Ordnance, his former duties as editor of ARMY ORDNANCE. He became associate editor of this journal in 1923, editor in 1929. Roger E. Lewis, associate editor of the publication since 1936, has been appointed managing editor.

General Burns Honored.—Elsewhere in this issue announcement is made of the award of the Oak Leaf Cluster to Maj. Gen. James H. Burns. The honor is in addition to the Distinguished Service Medal he received for his outstanding service in World War I. We make particular mention of this award because General Burns retired from active military duty December 31, 1944. Throughout the present war, he held most important responsibilities as a member of the Munitions Assignments Board and as such served with the Combined Chiefs of Staff. Illness during recent months caused his retirement.

General Burns, throughout his long military career, had a remarkable influence on the development of industrial mobilization planning in the Army and in industry. His many years of service in the Ordnance Department in command of arsenals, depots, and divisions of the Office of the Chief of Ordnance gave him an experience seldom equaled by any other officer of the Army. In addition, his keen judgment, unflagging energy, and crystal-clear perception combined to qualify him for the high office of Chief of Ordnance to which he was appointed in May 1942. Although the appointment was confirmed by the Senate, it was later withdrawn by the President in order that General Burns might remain with his important duties on the Munitions Assignments Board.

It is no overstatement of fact to record that General Burns' service to the Ordnance Department, to the Army, and to the Nation is not surpassed by any other one man. He led the thinking and guided the planning of industrial preparedness during peace, and his basic doctrines and plans, without change in one single instance, are today responsible for the great progress of American arms and armament. The Ordnance Department and all his friends throughout the rest of the Army and in industry acclaim General Burns for the man that he is and the things he has done.

A Hero and His Gun.—Pfc. Henry Schauer was awarded the Medal of Honor by the War Department in the name of Congress for heroic conduct the like of which is seldom surpassed in battle. In republishing the following citation which accompanied the award we do so in tribute to a fearless man, his superior training, and his matchless weapon. Heroism of the individual infantryman is still the fine arbiter of battle, but without a dependable weapon of superior firepower the price would be far greater in all cases. In extending our congratulations to Private Schauer, we congratulate also those who trained him in the art of war and likewise one John M. Browning who developed the principle and the weapon which made this heroic act possible. The citation follows:

"For conspicuous gallantry and intrepidity at the risk of his life above and beyond the call of duty. On 23 May 1944 at 1200 hours, near Cisterna di Littoria, Italy, Private Schauer left the cover of a ditch to engage four German snipers who opened fire on the patrol from its rear. Standing erect, he walked deliberately thirty yards toward the enemy, stopped amid the fire from four rifles centered on him, and with four bursts from his Browning automatic rifle, each at a different range, killed all of the snipers. Catching sight of a fifth sniper waiting for the patrol behind a house chimney, Private Schauer brought him down with another burst. Shortly after, when a heavy enemy artillery concentration and two machine guns temporarily halted the patrol, Private Schauer again left cover to engage the enemy weapons singlehanded. While shells exploded within fifteen yards, showering dirt over him, and strings of grazing German tracer bullets whipped past him at chest level, Private Schauer knelt, killed the two gunners of the machine gun only sixty yards from him with a single burst from his Browning automatic rifle, and crumpled two other enemy soldiers who ran to man the gun. Inserting a fresh magazine in his Browning automatic rifle, Private Schauer shifted his body to fire at the other weapon 500 yards distant and emptied the weapon into the enemy crew, killing all 4 Germans. Next morning, when shells from a German Mark VI tank and a machine gun only 100 yards distant again forced the patrol to seek cover, Private Schauer crawled toward the enemy machine gun, stood upright only 80 yards from the weapon as its bullets

cut the surrounding ground, and 4 tank shells fired directly at him burst within 20 yards. Raising his Browning automatic rifle to his shoulder, Private Schauer killed the four members of the machine-gun crew with one burst of fire."

For the Book.—From the energetic Col. Clyde H. Morgan, chief of the St. Louis Ordnance District, comes the following letter sent to him by an ordnance producer in his district. Name, location, signature, and product have been deleted. What cannot and must not be revised is the spirit, determination, and good plain Americanism of the writer and his associates. Here is a sample of the will to win shown so commendably by American industry toward the winning of the war. This gentleman's experiences with red tape are not unfamiliar to the rest of us. We publish the letter believing that every member of the Army Ordnance Association will be a sympathetic reader.

"In reviewing our production problems, we can recall when our wages were frozen at a low level; Selective Service got its share of our experienced employees; the War Manpower Commission has had a field day in diverting to other parts of the country our employees; the surrounding Ordnance plants took their share; we have now the lowest type of humans any one could find, yet we find that we are shipping more with 68 employees than we did with 125 a year ago.

"How was this accomplished? Between nightmares, we mechanized our operations, eliminated all plant double handling, closed our eyes to some manufacturing standards —but, chum, the Army and Navy got their widgets; so did the Marines in spite of a total fire which destroyed our plant in October 1943. Our new plant was in operation December 1st of the same year. Trouble? Hell yes, plenty of it, but, chum, you got your——widgets!

"I get a kick out of seeing Army-Navy "E's" pinned on plants where wage levels were high enough to keep their experienced employees, with all controlling war agencies helping them to get the job done. This is not sour grapes as I'm sure this was needed to get the job done. Believe it or not, no one ever looked our way except the guy who needed the widgets.

"In February 1942, I took over this business and went after war contracts. Our sales for that year ran $100,000. In 1943, in spite of the fire, our sales ran $200,000 and this year will run a little over $300,000.

"With reference to personnel, we have a good number of employees who will go back to WPA as soon as they can be replaced with better stuff. Our experience with Ordnance officers and all other buying war agencies has been most cordial. Had it not been for this angle, chances are somebody else would have supplied widgets besides the writer. Hope this gives you a fair sketch of our contribution."

The Ladies—God Bless 'Em!—It is a far cry from the small Ordnance district offices of prewar years to the gigantic organizations now conducting the Ordnance production program in the thirteen Ordnance districts. Yet the work of the districts in those years of planning was most vital and was magnificently done—on a shoestring! Strange as it may seem, personnel of the Ordnance districts was restricted by *Congressional fiat* (if former Congressman Ross Collins of Mississippi reads this, he will remember well) to one Ordnance officer and one civilian employee. The civilian employee was a young lady of secretarial accomplishments who conducted the routine operations of the office.

Because that little group of loyal Ordnance ladies had so much to do with the success of our Ordnance operations in the present war, we here and now call the roll of their names: Miss Helen K. Slinkman, Baltimore; Miss Irma E. Koonce, Birmingham; Miss Bertha C. Milliken, Boston; Miss Jenny E. Nelson, Chicago; Miss Gladys Maloney, Cincinnati; Mrs. Betty Brown, Cleveland; Mrs. Josephine P. McKenzie, Detroit; Mrs. Ruth M. Cousens, New York; Miss Helen V. Meehan, Philadelphia; Mrs. Katherine L. Moyer and Miss Lillian B. Osborne, Pittsburgh; Miss Jesse M. Cullen, Rochester; Miss Bernice M. Sharpe, St. Louis; Miss Rowena M. Peters, San Francisco; Mrs. Myrtle C. Latham, Springfield (Mass.). And at Washington headquarters was Miss M. A. Lewis—versatile and loyal expert on district administration.

We wish to make special remembrance of Miss Betty Bradfield, formerly with the Birmingham District, who was attached to the Philippine Ordnance Depot in Manila when the Philippines were invaded by the Japanese in 1941, since which time she has been a prisoner of the enemy. Her many friends hope and pray for her quick and safe return.

What prompted the above paragraphs was news from the Rochester Ordnance District of the retirement of Miss Cullen, who was the guest of honor at a dinner of Ordnance employees attended by Col. Frank J. Atwood, Rochester Ordnance District chief, on September 16, 1944, at Schenectady.

A veteran of more than twenty-six years' service in the Ordnance Department, Miss Cullen became the first civilian employee of the Rochester Ordnance District when this procurement organization, which covers most of New York State outside of the metropolitan New York area, was established. Since 1940 she had been assigned to the office of the Army Inspector of Ordnance at the American Locomotive Company plant in Schenectady. Her home is at 609 McClelland Street, Schenectady.

Miss Cullen entered civilian service of the Ordnance Department January 21, 1918, at Watervliet Arsenal. When the Department's district procurement system of World War I was projected into the present system of thirteen Ordnance districts, she was assigned as secretary to the executive officer of the Buffalo District, headquarters of which were then located at Watervliet Arsenal. The name of the district was subsequently changed to the Rochester Ordnance District, and headquarters were established in Rochester for the planning of wartime Ordnance procurement in upstate New York. Brig. Gen. R. E. Hardy, now chief of the Ordnance Department's important Ammunition Division, then a captain, was the first executive officer of the district.

Until 1939, Miss Cullen served as secretary to the several executive officers of the district. The first district chief was Col. Ledyard H. Cogswell, Jr., of Albany, succeeded by Erwin R. Davenport, of Rochester, who served until 1942 and who is now chairman of the district advisory board. When expansion for the present war began, Miss Cullen was made office manager at Rochester, and in 1940 she was assigned to the newly opened office of the Rochester Ordnance District's Army Inspector of Ordnance at the American Locomotive Company. In 1944 she was awarded the War Department Emblem for Meritorious Civilian Service.

Ammunition

An Editorial

THE Industry-Ordnance team is on an all-out basis for the production of artillery ammunition. No element of the American people understands the present critical situation more accurately than members of the team. And no one group will do more in working 'round the clock to make sure that all increased demands will be met as quickly as possible. GI Joe shall be kept in superior firepower just as fast as the team can make it. That was the Industry-Ordnance team's pledge in 1939—two years before Pearl Harbor; it is reaffirmed now with the same deep determination.

¶ The increased Ordnance demands from European and Asiatic battle fronts are especially great for small-arms and artillery ammunition. The field artilleryman as well as the infantryman has reasserted his strong position in combat. Battle fire of each gun formerly calculated in the hundreds of rounds now has increased to thousands. To break the will of a determined enemy requires terrific and continuous artillery as well as air bombardment. Supplies on the battlefields and in the depots are devoured ravenously. America's will to produce must surpass the enemy's will to continue fighting. He must be blasted into submission!

¶ For victory's sake and GI Joe's safety, the Industry-Ordnance team will keep the small-arms and artillery ammunition production going full blast. It will pass the ammunition until the last gun has fired. The team has met all demands in the past. So it shall be to the end. Better a surplus of ammunition when the war is done than the needless loss of the life of one GI Joe. In God's name, keep the ammunition production lines going and—until the battle commanders give the word—"Damn'd be him that first cries, 'Hold, enough!' "

Association Affairs

INDUSTRY DIVISIONS OF THE ASSOCIATION

PLANS are now in process for the formation within the Army Ordnance Association of special divisions, the members of which are especially interested in some particular phase of ordnance. The first of these divisions will be known as the Ammunition Industry Division. To it will be assigned all members who are connected with or especially interested in the design, production, supply, and maintenance of the various types of artillery ammunition. Later on, it is proposed to form an Automotive Industry Division, a Metallurgical Industry Division, and others.

Formation of the Ammunition Industry Division is under the direction of a committee under the chairmanship of H. C. Knowles, vice-president, Procter & Gamble Company, Cincinnati, Ohio, and a director of the Army Ordnance Association. Other members of Mr. Knowles' committee are: Arnold Hanger, vice-president, Mason & Hanger Company, New York City; Harvey S. Firestone, Jr., vice-president, Firestone Tire & Rubber Company, Akron, Ohio; and Kenneth A. Spencer, Military Chemical Works, Inc., Kansas City, Mo.

The first objective in recruiting the Ammunition Industry Division will be to have at least one hundred members from among the key personnel of each of the principal ammunition, explosives, and loading plants throughout the country. Work of the division will be coördinated at all times with the Office of the Field Director of Ammunition Plants, St. Louis, under the direction of Col. T. C. Gerber.

TWIN CITIES POST

PLANS are under way for the formation of the Twin Cities Post of the Army Ordnance Association due to the interest and enthusiasm of members resident in Minneapolis and St. Paul. The initial step was taken at the Minneapolis Athletic Club on October 18, 1944, when some twenty-odd leaders of industry and Ordnance in that area held a preorganization meeting to discuss the formation of the proposed local chapter. The meeting was called by Maj. Roland F. Wilson, who served as chairman. Major Wilson is an Ordnance Reserve officer of outstanding service who has devoted many years to Ordnance affairs in District activities and as a member of several local Posts.

Col. L. A. Codd, executive vice-president of the Association, outlined to those present the purposes of a local chapter and emphasized the great service to be performed in postwar years by influential, well-informed groups of members organized in local Posts throughout the country. Those present agreed enthusiastically to the formation of the Twin Cities Post, and a petition to the directors of the national Association for the formation of the Post is now in preparation.

Others present at the luncheon-meeting were: W. C. MacFarland, Sr., W. C. MacFarland, Jr., Luther Oakes, Frank Winston, Harold Sweatt, Alfred Wilson, Clifford Scott, C. L. Horn, Bud Onan, Lucien Strong, Fred Blumers, Harry Bullis, Wirt Wilson, Lieut. Col. A. V. Stallard, Lieut. Col. O. B. Jacobson, Capt. A. J. Beyer, and Robert J. Doyle.

SAN FRANCISCO—LOS ANGELES—PUGET SOUND POSTS

SEIZING the opportunity afforded by a recent unexpected inspection trip by Maj. Gen. L. H. Campbell, Jr., Chief of Ordnance, to Ordnance installations, the three local Posts of the Army Ordnance Association on the West Coast held meetings at which General Campbell graciously consented to speak. The meeting of the Puget Sound Post was held on October 12, 1944; of the San Francisco Post on October 16th; of the Los Angeles Post on October 17th. In all cases there was a goodly representation of members, notwithstanding the shortness of the notice of the General's visit.

San Francisco Post.—During the past few months, the membership of Army Ordnance Association Posts in the San Francisco Ordnance District, which comprises nine western states, has shown a most creditable increase, and this was reflected by the splendid turnout of members at the luncheon in the St. Francis Hotel in San Francisco.

Charles Kendrick, president of the Schlage Lock Company, and vice-president of the San Francisco Post, served as master of ceremonies and called attention to the new strength and the increased membership of the San Francisco organization. He praised Col. K. B. Harmon, chief of the San Francisco Ordnance District, for his effective leadership and paid high tribute to the enthusiasm shown by Col. Dean Witter, deputy district chief, in recruiting members for the Association.

In San Francisco, it was especially noticeable that the visit of General Campbell attracted key men from newspaper and top-flight executive circles. In addition to the visiting Army personnel at the St. Francis Hotel speakers' table were such prominent civilians as J. R. Knowland, publisher of the *Oakland Tribune;* Bill Chandler, managing editor of the *San Francisco Chronicle;* Lee Ettelson, managing editor of the *Call-Bulletin;* Charles Mayer, business manager of the *Examiner;* Frank Clarvoe, editor of the *San Francisco News;* Ingraham Read, publisher of the *Oakland Post-Enquirer;* Maj. Gen. Paul B. Malone, Blue Network military commentator; Tom Rolph, Congressman from California's Fourth Congressional District; R. C. Force, president of Caterpillar Tractor Company and president of the San Francisco Post of the Army Ordnance Association; H. C. Hendee, editor of the Pacific Coast edition of the *Wall Street Journal;* Samuel Kahn, president of the Market Street Railway and chairman of the Advisory Board, San Francisco Ordnance District; and Charles Moore, president of Joshua Hendy Iron Works and vice-president of the San Francisco Post.

Los Angeles Post.—In Los Angeles, Carleton Tibbetts, president of the Los Angeles Steel Castings Company, won applause as master of ceremonies at the Ambassador Hotel meeting. William C. Mullendore, acting president of the Los Angeles Post, was the principal local speaker. There were 177 members of the local chapter present. In addition to the guests already named, others at the speakers' table were: Brig. Gen. D. F. Stace, commanding general, Army Air Forces' Western Procurement District; Rear Adm. J. R. Defrees, Inspector of Naval Matériel, Los Angeles; Col. K. B. Harmon, chief, San Francisco Ordnance District; Col. L. A. Skinner, Ordnance liaison officer, California Institute of Technology; Col. S. Glazier, post Ordnance officer, Los Angeles Port of Embarkation; Lieut. Col. C. A. Phelan, commanding officer, Los Angeles Ordnance Depot; and Maj. Walter C. Main, officer in charge, Los Angeles Ordnance Region. Arrangements for the meeting were under the direction of F. B. Cole, member of the board of directors.

General Campbell, in his talks, stressed the importance of industrial preparedness and urged that the United States never again relax its efforts to keep fully prepared. He told with real pride of the marvelous accomplishments of the Industry-Ordnance team in arming and equipping our fighting forces with the best and most effective weapons in the world today.

Accompanying General Campbell on his western inspection trip of arsenals, depots, and Ordnance installations, were the following officers from the Office of the Chief of Ordnance, who also were honored guests at both the San Francisco luncheon and the Ambassador Hotel dinner: Brig. Gen. W. P. Boatwright, commanding general, Office of the Chief of Ordnance—Detroit; Brig. Gen. E. L. Ford, chief, Reclamation and Maintenance Division, Office of the Chief of Ordnance; Col. O. P. Winningstad, Office of the Chief of Ordnance—Detroit; Col. F. A. McMahon, Office of the Chief of Ordnance; Col. P. R. Faymonville,

Signal Corps

LUNCHEON-MEETING OF THE SAN FRANCISCO POST OF THE ARMY ORDNANCE ASSOCIATION

Office of the Chief of Ordnance; and Maj. T. J. Moore, Jr., aide to General Campbell.

Puget Sound Post.—The meeting of the Puget Sound Post was held at Seattle on October 12th with a large representation of members and guests present. For a bird's-eye view of the meeting and the principal address, we quote the following excerpt from the account published in the *Seattle Post Intelligencer:*

"An avowed realist in his outlook on war, Maj. Gen. L. H. Campbell, Jr., Chief of Ordnance, last night warned Ordnance contractors of the Seattle-Tacoma area to be ever mindful of preparations for the 'next war.'

" 'Preparedness must be your policy,' said General Campbell, in a dinner address at the Olympic Hotel arranged by the Puget Sound Post of the Army Ordnance Association and the military affairs committees of the Seattle and Tacoma Chambers of Commerce. 'Keep your association alive. When the next war comes—and it *will* come, for wars will be fought as long as men are human—be ready. If we are set it will save precious time and more precious lives.'

"Urging uninterrupted drive and production after Germany's defeat, General Campbell said there should be no celebration on X-day but rather a 'solemn rededication of all our strength and resources to the war effort.'

" 'Every American should be made to realize we will only be at the halfway point when the Nazis fall. As for the Japs, it is my hope that when we get through with them there will be plenty of room for all of them on their own little island. We should make sure that they will not need China's land. You men and the plants you manage are now no small part in the Nation's industrial setup. We of Army Ordnance are proud of the part we have played in the future progress of industrial development in the Northwest.' "

NEBRASKA POST

THE fall meeting and dinner of the Nebraska Post, Army Ordnance Association, was held on the evening of November 22, 1944, with Col. Clyde H. Morgan, chief of the St. Louis Ordnance District, as honor guest and principal speaker. The meeting was held at the Fontenelle Hotel. Some 350 members and guests were present to greet Colonel Morgan. Karl E. Vogel, president of the Post, presided. A feature of the meeting was an exhibit of Nebraska-made ordnance items which created considerable interest. Addresses were made by Walter Smith of the St. Louis Ordnance District office, Charles Ammon of the Cushman Motor Works, Lincoln, Nebr., and Col. Richard Coward, who introduced Colonel Morgan.

Since November 1, 1944, the Nebraska Post has added 225 new members to its roster. Nebraska is now the second largest Post in the St. Louis District and claims more members per capita of state population than any other local chapter in that area. Arrangements for the meeting were in charge of the officers of the Post.

BIRMINGHAM POST

MAJ. GEN. CHARLES T. HARRIS, JR., commanding the Aberdeen Proving Ground, was the principal speaker at the annual meeting of the Birmingham Post, Army Ordnance Association, November 3, 1944, at Mountain Brook Club, Birmingham, Ala. Col. George M. Morrow, president of the Post, presided, and Oscar Wells, director of the Post for many years, was toastmaster. General Harris spoke on the subject "Old Weapons and New." His paper was historic in many respects and is published in full on page 69 of this issue.

Col. L. A. Codd, executive vice-president of the Army Ordnance Association, spoke briefly on the present status of the organization and its plans for strengthening Ordnance leadership and industry for the winning of the war and for the coming peace.

The committee in charge of the meeting was under the chairmanship of Lieut. Col. Allen Rushton, vice-president of the Post, who was recently chosen a director of the Association, representing the Birmingham Post. He was ably assisted by Maj. Roy Hickman, an active proponent of Ordnance activities throughout the South. Other officers and directors of the Post who took part in arrangements for the meeting included, in addition to those already named: Lindley C. Morton, Thomas W. Martin, Col. Theodore Swann, Lieut. Col. Richard J. Stockham, Thomas E. Kilby, Jr., Robert Gregg, Merrill E. Pratt, W. D. Moore, Lieut. Col. Thomas M. Nesbitt, Jr., and Lieut. Col. Ralph E. Parker.

TEXAS POST

THE annual meeting of the Texas Post was held in the ballroom of the Rice Hotel, Houston, Tex., on October 19th and began with a fellowship hour from 6:30 to 7:30 P.M. Dinner was served at 7:30 with 160 members of the Post present. B. T. McNeil, president of the Post, acted as chairman.

Following the dinner, Mr. McNeil announced that the newly elected officers of the Post were: President, W. R. England, Houston; vice-president, Dewey D. Day, Dallas; secretary-treasurer, Capt. George G. McDonald, Houston; and that the following directors had been chosen to serve for two years: M. J. Neeley, Fort Worth; B. T. McNeil, Houston; C. C. Chambers, Lufkin.

Mr. McNeil then made a most impressive and earnest plea for continued interest in the preparedness program of the Army Ordnance Association, stressing the advantages of life membership in the organization. He then introduced W. R. England, the newly elected president, who outlined plans for the Texas Post for the coming year. Among these plans were the proposal to hold small group meetings at various points throughout the state which would offer an opportunity for attendance by the membership located in other areas, a new directory of the membership of the Texas Post, and plans for an active membership drive throughout the entire state of Texas.

Col. R. W. Coward, assistant district chief of the St. Louis Ordnance District, then introduced Col. Clyde H. Morgan, the new chief of the district, who assumed his duties in St. Louis on September 1, 1944.

In the principal address of the evening, Colonel Morgan reviewed the history of the Ordnance Department and the work of the Ordnance-Industry team in preparing for the present war. He praised American ordnance and cited interesting figures about the number of new weapons developed, explaining that the normal time required for developing and producing a new item had been greatly reduced.

Passing from the field of achievement to that of new problems, Colonel Morgan discussed the timely subject of reconversion. "When final victory is achieved," he said, "we shall be faced with the immediate problem of terminating the then-existing contracts and restoring all industries at the earliest possible date to their normal production. To that end we are working directly with the contractors in their plants to settle in advance all factors involved. A price schedule for Government-owned facilities and machine tools has been set up so the contractor can plan now for those items he desires to retain. For the remaining equipment, plans for disposal of property and processing machine tools for storage have been and are being made."

Colonel Morgan ended his address with an appeal for continued and increasing coöperation of the Industry-Ordnance team. "Engraved in stone on the beautiful National Archives Building in Washington appears this phrase, "What's past is prologue." It behooves us to think now of ordnance and the Army Ordnance Association in the postwar world. Certainly the Industry-Ordnance team welded together in the white heat of war will remain firmly united for all days to come. The Army Ordnance Association will remain the spokesman for industrial preparedness. It will be the American Legion for industry—the veterans' organization, if you please, for the contractors that have waged and won the war. It will be their grave responsibility to pass on to succeeding generations the experience of the past—both the mistakes and the achievements. No greater responsibility can be assigned." And none will be undertaken more heartily!

Boston Post

THE following officers and directors have been elected by the Boston Post of the Association: President, H. P. Richardson, First Boston Corporation; vice-presidents, Clifford Roberts, vice-president, Research Division, United Shoe Machinery Corporation, and Lieut. Col. H. W. Bagnall, U.S.A., Retired; secretary-treasurer, Maj. J. E. Ratigan, Boston Ordnance District.

The directors of the Post, in addition to the officers, are: J. P. Spang, Jr., president, Gillette Safety Razor Company; Thomas West, president, Draper Corporation; R. N. Greenwood, president, Heywood-Wakefield Company; D. F. Edwards, president, Saco-Lowell Shops; Henry S. Chafee, president, Builders Iron Foundry; Milton P. Higgins, treasurer, Norton Company; Lieut. Col. C. S. Robinson, Massachusetts Institute of Technology Post; James L. Martin, Watertown Arsenal; George Sweet, executive assistant, Boston Ordnance District.

Necrology

EDMUND A. RUSSELL, chairman of the board of directors of the Chicago Post of the Association and for many years chief of the Chicago Ordnance District, died at his home in Lake Forest, Ill., October 25, 1944.

He was a leader in the cause of Ordnance preparedness for more than a quarter of a century and took an outstanding part in the mobilization of American industry for World Wars I and II. His loss to the Association and to the Ordnance Department at this time brings a keen realization and appreciation of his unflagging devotion to industrial preparedness.

Born in New York City, July 1, 1866, he was educated at the Brooklyn Polytechnic Institute. In 1883, he became associated with the elevator industry, and throughout his entire active career his interests and accomplishments were in that field.

Chosen by Maj. Gen. C. C. Williams, then Chief of Ordnance, for the newly organized district system in 1918, Mr. Russell brought together, in a minimum of time and with maximum effect, the industrial strength of the Chicago area for the production of military armament. Following World War I, he continued as chief of the Chicago Ordnance District, being active in the survey of plant facilities for postwar use. As chairman of the board of directors of the Chicago Post, he presided at many of its meetings and gave yeoman service in keeping alive an interest in Ordnance equipment. For his service in World War I he was awarded the Distinguished Service Medal. All members of the national Association join with their fellow members of the Chicago Post in expressions of sympathy for Mr. Russell's family and for the loss of a gallant leader.

LIEUT. COL. WILLIAM N. SPINRAD, an active member of the Washington Post of the Association, died in France, September 22, 1944, while on active duty in connection with Ordnance operations there.

An expert rifle and pistol shot, he reported in 1940 for active duty in the Office of the Chief of Ordnance as executive assistant to the chief of the Administration Division. In 1943 he was assigned to the Ordnance School at Aberdeen Proving Ground, Md., and in January 1944 to the staff of the Fourth Army. In June 1944 he went overseas and served as a member of the headquarters staff of the Ninth Army. He died shortly after the capture of some 19,000 German prisoners by that army. While on duty in the Office of the Chief of Ordnance, Colonel Spinrad for a time was editor of the *Ordnance Digest*.

NOTICE also has been received of the deaths of the following members of the Association: T. N. Armstrong, Jr., Summit, N. J.; Louis Battey, Greenfield, Mass.; D. J. Campbell, Muskegon Heights, Mich.; M. J. Carlson, Newington, Conn.; Carl Claus, Bound Brook, N. J.; John W. Converse, Philadelphia, Pa.; Dwight I. Cooke, Washington, D. C.; J. C. Dilworth, Pittsburgh, Pa.; Archibald Douglas, New York, N. Y.; John Gwynne, Aberdeen Proving Ground, Md.; Andreas Hartel, Jr., South Boston, Mass.; John E. Heath, Clairton, Pa.; Eugene A. Leary, Cincinnati, Ohio; F. V. Moore, York, Pa.; Conrad T. Neitzel, Dallas, Tex.; C. F. Niemann, Pittsburgh, Pa.; Charles H. Oshei, Detroit, Mich.; W. H. Parker, Pittsburgh, Pa.; Joseph S. Pendleton, Calcium, Pa.; J. H. Roberts, Atlantic City, N. J.; B. D. Saklatwalla, Pittsburgh, Pa.; Raymond L. Spragle, St. Charles, Mo.; Samuel G. Stafford, Coraopolis, Pa.; A. F. Sulzer, Rochester, N. Y.

Rockets

LAUNCHERS AND PROPELLANTS NOW IN MASS PRODUCTION

ROCKET projectiles, launchers, and propellants are being produced in scores of war plants throughout the Nation. Hundreds of thousands have been required so that Army planes and ground troops could carry rocket warfare to Axis shipping, fortifications, communications, and personnel. In the China-Burma-India theater and in Western Europe, troop concentrations, railways, radio stations, and storage depots have felt the blast of American rockets.

Although officers of the Ordnance Department pioneered the American use of rockets as long as twelve years ago, research and development since 1941 have been a joint undertaking of the War Department, Navy Department, and the Office of Scientific Research and Development—a civilian pool of top-notch scientific and engineering experts mobilized for war research. Working with these agencies have been two National Defense Research Committee groups, one at the California Institute of Technology, Pasadena, Calif., and the other at George Washington University, Washington, D. C. The Ordnance Department's own Rocket Research Division at Aberdeen Proving Ground, Md., works closely with OSRD and NDRC.

This war has seen rockets and the rocket plan of propulsion leap into prominence. Despite widespread use by virtually every belligerent, rockets still are largely in the experimental stage. Many problems connected with rocket manufacture and tactical use are still far from being solved. The new developments in rocket warfare are almost continual. The tactical use of rockets is in a state of flux. What is true today of range, accuracy, and battlefield use probably will not be true tomorrow.

By 1939, the rocket was still in its infancy, despite extensive research, especially in Germany. By 1941, however, it had become a recognized war weapon. In 1940-1941, the *Luftwaffe* met fire from British antiaircraft rockets, and that summer in Russia the Germans came under the blazing fire of the Soviets' famed multiple rocket launcher, "Katusha." The Nazis were not long in developing their own rocket weapons, of which the 6-barreled *Nebelwerfer* smoke mortar—"Screaming Meemie" and "Whistlin' Willie" to allied troops—is the best known. British rocket developments were made available to the United States, and for a time the Antiaircraft Command of the Army was interested, but by September 1941 interest was centering on aircraft-launched rockets and smaller antitank rockets. With the formation of NDRC as a technical advisory committee within OSRD to recommend and supervise contracts, research spurted ahead, with work being carried on at the California Institute of Technology and at Aberdeen Proving Ground.

THE four tactical uses of rockets are: (1) air-to-air, in which aircraft use rocket projectiles against other aircraft; (2) air-to-ground, in which aircraft use rockets against ground or marine targets; (3) ground-to-air, the antiaircraft use of rockets; and (4) ground-to-ground, in which ground forces use rockets against ground targets. The use of rockets from naval craft against ground targets is a variation of the latter. Rocket development in the United States has been aimed primarily at air-to-ground and ground-to-ground use. The Germans have experimented with air-to-air rockets against large formations of allied bombers, but without conspicuous success. Although we are on the offensive, however, and do not anticipate a need for large-scale antiaircraft defenses, air-to-air and ground-to-air rocket warfare has not been neglected by our scientists and experimenters.

Our air-to-ground assaults have been successful all over the world. Army Air Forces' P-40's, P-38 Lightnings, P-39 Airacobras, P-37 Thunderbolts, and P-51 Mustangs have been fitted with rockets slung in under-wing racks. In Burma, Army planes have combined rocket fire with bombing. Planes have raked Japanese installations with rocket, cannon, and machine-gun fire almost simultaneously and then finished the destruction with bombs of up to 1,000 pounds. Prime aircraft rocket targets include armored concentrations, rail lines and rolling stock, truck and troop convoys, light field fortifications such as bunkers, pillboxes, and artillery emplacements, radio installations, and light naval and cargo craft. In Europe, retreating Nazi troops are strafed heavily by both British and American rocket-firing planes. Aircraft rockets permit fighter and light bomber or attack planes to hurl greater concentrations of fire than their own cannon or machine guns can deliver and to hurl them with greater accuracy than the equivalent weight of free-falling bombs. Aircraft rocket development has been a combined effort by the Ordnance Department and Army Air Forces' Technical Service Command.

THE principal advantages of rockets are great firepower and mobility. Because they have no recoil, they may be launched from light, mobile, inexpensive and easy-to-manufacture launchers—far lighter and cheaper than guns which would throw a comparable weight of standard ammunition. The disadvantages of rockets are the subject of constant study in an effort to minimize or solve them. Rockets are inaccurate in comparison with guns. As a result, rocket fire is generally area fire. This inaccuracy, although it is being at least partially corrected, is the principal reason why rockets will only supplement standard artillery in this war.

Rockets also presented new manufacturing problems, chief of which is the propellant. This involves not only the propellant itself, which must have certain qualities of stability through a wide temperature range and a desirable rate of burning, but also the problem of forming it into sizes and shapes suitable to mass-production techniques. Arming devices present another obstacle. Artillery shells, for safety in handling, have a device which keeps the fuze from operating until after the shell is fired. The release of this device is called "arming" the fuze. New principles and mechanisms had to be worked out for arming rocket-projectile fuzes. These problems had to be solved so quantity production would be possible and finished products might be transported and stored safely and used easily and efficiently in the field.

The rocket is a complete "gun" by itself. It has been called "ammunition without ordnance—the soul of artillery without the body." It moves forward because of the push of expanding gases in a tube against the base of the rocket head. These gases generated by powder, electrically ignited in the tube, react against the rocket itself rather than against the air, as is commonly believed. As a matter of fact, rockets operate more efficiently in a vacuum than in the open air. Rockets consist basically of: (1) the explosive head, which may contain high explosive, smoke, or incendiary chemicals; (2) the motor, a tube extending to the rear of the head and containing the propellant, a material burned in the motor to release gases; (3) the nozzle, which is the flared and tapered end of the motor; and (4) in some types of rockets, the fins, which stabilize flight.

Most widely used U. S. rockets today are the Army's bazooka rocket and the 4.5-inch M8 projectile. The original bazooka, produced by the Ordnance Department and NDRC in the spring of 1942 after a full year of experimentation, was a 54-inch tube with a handgrip and a simple battery attachment which ignited the rocket. The bazooka's length made it unwieldy in the jungle, so the folding bazooka, a 61-inch tube which breaks down into two parts for greater ease in carrying, was developed. The bazooka can be operated by one man, but the usual team consists of two—a loader and a firer.

The bazooka was developed primarily for antitank use. It fires a 2.36-inch projectile, highly effective against armor. Bazooka teams have knocked out even the giant German Tiger tanks. In one case a GI bazooka man blew the turret off a Nazi tank from seventy-five yards. In a single day of fighting, two-thirds of a German *Panzer* force was knocked out or damaged by bazooka teams and aircraft rockets. The bazooka rockets themselves do not penetrate armor, but punch a hole through thick steel plate by a terrific concentrated and directed blast effect that throws hot fragments of steel around inside the tank. In some cases, rockets have blasted as much as six inches of armor plate.

The Nazis, who have developed several excellent rocket weapons, thought so highly of the bazooka that they copied it in a larger caliber. The German version is a poor copy, however, and is not considered by our Ordnance experts in anything like the same class as the American weapon. The 4.5-inch rocket, launched from planes and vehicles, is the most widely used of the medium-caliber rockets. The 4.5 has an explosive effect equivalent to that of a shell from a 105-mm. howitzer; yet it may be launched from a launcher that weighs but a fraction of a howitzer. American planes may carry 3-tube clusters of 4.5-inch launchers under each wing. Ground launchers, of which there are many types, may have many tubes or launching slides.

The only ground launcher which the Army has so far made public is the M12 artillery rocket launcher, consisting of a single plastic tube which serves both as a carrying case for its rocket and as a launcher (illustration on page 78). The tube has three legs attached to it and may be set up for firing from a foxhole, from against a tree, or in the open. The launchers may be wired into batteries to hurl salvos of 4.5-inch projectiles into enemy positions. The M12 is easily carried by one man. Several may be loaded into a jeep and rushed into action. Launchers may be made of plastic or light metal, without any of the complicated recoil devices and breech mechanisms of standard artillery. They may consist of nothing but a rail or slide fitted with an electrical ignition attachment.

ROCKETS and rocket warfare are not new, even though their development is one of the few innovations of this war. This war marks the third time in military history that rockets have played an important part in battle.

The Chinese used them in the thirteenth century and they were in fairly wide use in European warfare between the fourteenth and sixteenth centuries, but rocket use fell off with an improvement in accuracy and mobility of the cumbersome cannon of the time. They reached their next great period of popularity in the nineteenth century, when Britain's Sir William Congreve developed a military rocket used in the burning of Copenhagen, the siege of Danzig, and against our own Fort McHenry at Baltimore, where the "rockets' red glare" gave birth to our National Anthem. The Ordnance Department produced rockets which were used by our Army in the Mexican War of 1846-1848.

Rocket corps were organized by many European nations, but after the middle of the century, with the arrival of the rifled bore and modern sighting and fire-control apparatus, artillery regained its place. Rockets survived mainly as fireworks or as signal equipment, although there are a few instances of their use in World War I. Numerous rocket experiments were carried out in the 1920's and 1930's, largely in Germany and Russia. In this country, Dr. C. N. Hickman and Dr. Robert H. Goddard made progress in research. Dr. Hickman produced a bazooka-like weapon as early as 1918, when he was engaged in war research. He is now with NDRC.

The Army pays high tribute to the work of the many contractors and subcontractors involved in the multimillion-dollar rocket program. In many cities, secrecy was so well kept that labor recruiting was made difficult because local workers did not know the plants were engaged in war work.

New Developments

New Chemical Warfare Weapons

DETAILS of four new chemical warfare weapons, the jungle flame gun, flame-throwing tank, smoke drake, and gas-detector kit, have recently been revealed. The weapons, which have been classified items, have been in production for some time and have already proved their effectiveness in combat zones.

The jungle flame gun, a portable flame thrower, was especially designed for use in tropical climates. Known officially as the M2-2 portable flame thrower and informally as the "atomizer," the apparatus was built to fire jellied oil, a thickened fuel made of blazing oil chunks which spatter and cling to the target. Since this fuel is best fired under tremendous pressure, the gun incorporates leakproof piping of great strength.

The range of the earlier M1A1 model with thickened fuel has reached sixty yards, but the much greater range of the new weapon has not been disclosed. The name, "atomizer," comes from a small atomizer hole in the nozzle which sprays a fine, readily ignited mixture as a booster to help start the main stream of oil. The M2-2 can fire either liquid fuel—a combination of gasoline and Diesel oil—or jellied oil—a mixture of gasoline and a special thickening compound which is brewed in the field and aged in drums for several hours before use. The thickened fuel produces ranges double that of the liquid fuel.

The flame tank, which moves into point-blank range of targets inaccessible to foot soldiers with portable flame throwers, can hurl a stream of blazing oil while speeding over rough terrain. The flame tank now in action consists of a standard M1A1 portable flame thrower mounted on either a light or medium tank. As the vehicle's driver maneuvers into position, the assistant driver operates the flame throwing apparatus, directing the cone of fire up and down and to either side like a spray hose.

The smoke drake consists of a standard M1 mechanical smoke generator mounted on an amphibious Duck. It glides through the water spouting clouds of dense white smoke or climbs on shore to roll across dry land. It is now in use for blanketing allied beachheads against enemy observation. The largest smoke machine in the world, the M1 generator, either on its new amphibious mount or on its standard trailer mount, converts one hundred gallons of special hydrocarbon oil into white fog every hour. One of the machines, with favorable weather conditions, can blot out a square mile in ten minutes.

The M9 chemical agent detector kit, which reacts with great sensitivity to several types of war gases, is a miniature gas-analysis set packed into a 2½-pound cotton duck carrier slung by a strap from the wearer's shoulder. In the hands of a trained soldier, this kit will detect the presence of both persistent and nonpersistent chemical agents. The M9 kit includes an air-sampling pump, bottles of chemical reagents, and scores of tiny detector tubes. These glass tubes hold special reagents which absorb toxic gases. There are differently marked tubes containing different chemical combinations, each type suited for the testing of a certain type of gas. The tubes turn various colors in the presence of different gases.

New Types of Gas Masks

A GAS mask to protect head-wound patients from war gas has been developed by the Chemical Warfare Service and is now in production. Known as M7-11-9, the mask is the first such device which affords protection to patients with bandaged heads, faces, or jaws. For use in hospitals and other installations vulnerable to gas attacks from the air, the mask consists of a silklike plastic

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New Developments

hood to which an air-purifying canister and an outlet valve are attached. A flexible window across the eyes provides clear vision. Air is drawn into the mask by the ordinary breathing of the wearer.

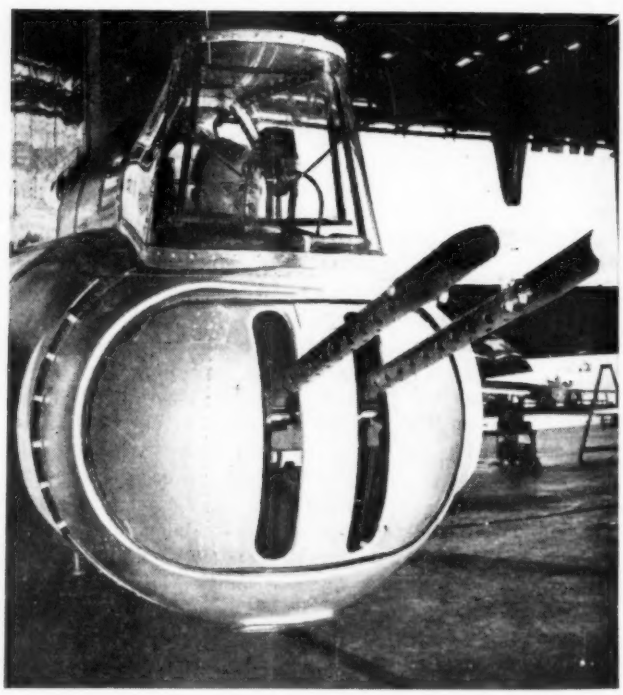
The Chemical Warfare Service designed the new mask at the request of the Medical Department, since standard military masks will not fit over head bandages. The head-wound mask is adapted for use over any type of head, face, or jaw dressing. The skirt of the hood fastens tightly around the neck or a gas-tight seal can be obtained by taping the hem to the wearer's chest.

A dog gas mask, which affords protection against chlorine, phosgene, and other choking gases, also has been adopted by the Chemical Warfare Service for use by war dogs. The mask weighs 2.1 pounds and will fit 97 per cent of all war dogs. The principal part of the mask is a coated duck muzzle piece which fits over the dog's snout and is made airtight by a neoprene rubber seal which goes around the head, just above the eyes. The incoming air is purified in two drum-shaped canisters screwed to the jowls of the muzzle piece. The outlet valve is just under the dog's snout. Although the mask was not designed to be worn while the dog is on battle duty, tests show some animals can operate effectively while masked.

Flying Fortress Gun Positions Improved

More sting in the "stinger," greater visibility for the gunners, more armor plating around the gun positions, staggered gun ports at the newly covered-in waist positions so that the gunners won't get in each other's way—these are the latest battle aids in the newest B-17 Flying Fortress bombers.

The B-17 tail gunner operates from a newly designed and smooth-functioning turret which gives the lethal twin .50's a 90-degree arc of fire throughout the cone as compared with



The New B-17 Tail Turret

60 degrees on the old type. The turret already has been battle-tested. Its full plexiglass sides and top give the gunner a better and quicker view of attacking fighters, its reflector sight gives him a better shot, and its armor plate—an all-around "flak curtain"—provides needed protection against antiaircraft and machine-gun fire. Additional protection also has been added in an expansive quadrangle of inch-thick bulletproof glass in front

New Developments

of the gunner's face. As for ammunition, the new stinger now can pour out half again as many rounds as the old type.

The waist gun ports in the airplane have been enlarged and closed with plexiglass to keep out the bitter stratosphere cold that long has benumbed fighting crewmen and to reduce noise. The modifications at the side positions also give the gunners a great deal more freedom of action.

A 2,000,000-VOLT X-RAY MACHINE

X-RAY pictures can be taken through pieces of steel a foot thick, using a new 2,000,000-volt relatively mobile X-ray unit developed by the General Electric Company. This doubles the voltage of X-rays available to industry for examination of metal sections to find defects. Up to now the most powerful X-ray unit in general use has been the 1,000,000-volt apparatus also developed by General Electric. More than fifty of these are now actively serving the war effort in the United States and abroad.

In radiographing an 8-inch steel casting the 2,000,000-volt outfit is seventy-eight times as fast as the 1,000,000-volt. For still thicker sections the ratio is even greater. The new unit weighs 5,000 pounds and can readily be moved by crane and positioned at any angle by push-button control of fractional horsepower motors.

ORDNANCE CALIBRATION TEAMS

SEVEN Army Ordnance calibration teams in Italy and Germany are employing new electronic equipment to increase the accuracy and to extend the battle usefulness of American heavy artillery. The new equipment, which can be installed in a 2½-ton Army truck and transported right up to the battle front, is capable of measuring the speed of projectiles within one one-hundred thousandth of a second.

It is always a difficult problem to get a projectile squarely on the target at ranges up to seventeen miles. Involved in this operation are such factors as the age of the gun, the quality of the ammunition, the curvature of the earth, and such additional factors as wind, temperature, and barometric pressure. These constantly changing factors necessitate complex mathematical calculations and the use of the most modern scientific devices in order that the highest degree of firing accuracy may be obtained and effective barrages laid.

Old guns and howitzers cannot shoot as far as new weapons. Obviously when guns of different ages are being fired together in battery at the same target, allowances have to be made for each used gun. Experts of the Ordnance Department not only calibrated or synchronized front-line batteries in Italy and Western Europe but also trained calibration teams to carry on this highly important activity.

This scientific work demonstrated that the life of gun tubes is much longer than previously assumed. In the past, gun crews discarded gun tubes rather frequently because they had no way of knowing the maximum efficient life of a tube and could not afford to take chances when the lives of our Infantrymen were at stake. Today's electronic instruments give them this knowledge and reduce considerably the artillery supply problem.

AN ELECTRONIC TIME-INTERVAL COUNTER

AMERICAN Army and Navy guns of all sizes are blasting the enemy on every war front with more deadly effectiveness than ever before because of amazingly accurate muzzle-velocity measurements, as precise as a hundred-thousandth of a second, made possible by a new electronic time-interval counter developed in RCA laboratories at Princeton, N. J. The instrument has been in use for more than a year at Aberdeen Proving Ground, Md., and at other Government arsenals and proving grounds throughout the country. It supplies instantaneously in-

THE FIGHTING FACE OF FITZGIBBONS

Not a smile in the lot—just grim, stern determination to do their job in getting out armored equipment. The men and women of Fitzgibbons work in the blinding glare of welding torches, in the shattering roar of heavy shears, punches, bending rolls. Thus are born the M-7 Tank Destroyers whose 105 mm. guns are today making hash of the toughest enemy tanks, and thus were made many of the famous General Sherman tanks that are chasing Rommel out of France. In the making of these things the men and women of Fitzgibbons have earned the Army-Navy "E" award, with star for continued effort.

When the present need is past, the men and women of Fitzgibbons will again make steel heating boilers, and air conditioners. Their job is, first to make America safe—then to make it comfortable.

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New Developments

formation upon which the performance of a given gun is established and the uniformity of its ammunition checked within a few seconds. It is equally effective with all types of guns.

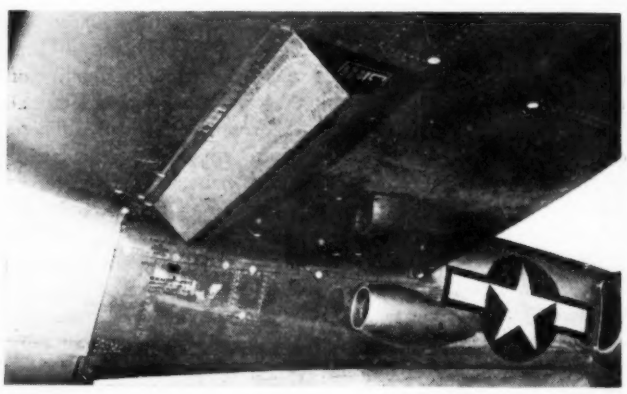
The counter consists of three essential parts: an oscillator, a gate, and the counter proper. The oscillator is regulated, as in a radio transmitter, by a vibrating quartz crystal and delivers precisely 100,000 pulses each second. The gate, actually a vacuum-tube circuit, passes these pulses into the counter which counts them and, when the gate is closed, shows by indicator lamps the number of pulses that have passed through. Extraordinary speed and accuracy of operation are possible because there are no moving parts; the entire apparatus is electronic and can be started and stopped instantaneously.

In operation on the firing ranges, the counter's gate is opened by the signal from an electrical coil as the projectile, which has been magnetized, passes through it and is closed again by the impulse from a second coil. The operator records the time of flight between coils and computes the velocity.

New Dive Flaps Overcome "Compressibility"

VICTORY has at last been achieved over the most baffling puzzle of modern fighter airplanes—the strange phenomenon of compressibility in high-speed dives. To the aërodynamicist compressibility has been a stone wall which has barred his aircraft from reaching the speed of sound. But to the fighter pilot, compressibility has been a phantom hand that seized his airplane during combat dives and shook it out of control.

After three years of incessant research by pilots and engineers of Lockheed Aircraft Corporation and of the Army Air Forces Matériel Command a device has been developed which overcomes the effects of compressibility. It consists of two hinged strips of metal smaller than a card table hinged to the under side of



The New Flaps Installed on a P-38 Lightning

the airplane wing and operated by a button on the pilot's control wheel. Where ordinary dive flaps serve primarily as a brake, the Lockheed flaps control the flow of air across the wing to defeat the phenomena of compressibility. They permit the Lockheed P-38 Lightning to dive at tremendous speed but still under full control. With the possible exception of the new German rocket fighter, the Lightning now can outdive any fighter it meets in the air. It is understood that the flaps have been successfully tested on another ranking American fighter and are under test on a third. They have been in full production on the Lightning for months, and "flap kits" are en route to the theaters for modification of earlier P-38 fighters whose speed first carried the airplane into the zone of compressibility.

The phenomenon may be likened to snow piling up in front of a plow and breaking loose in chunks. Masses of air pile up in front of the wing during sharp dives. These masses break off, roll back, and strike the tail surfaces so hard that the turbulence

New Developments

causes extreme buffeting of the airplane. Additional buffeting is set up in the wing itself by a conflict between two laws governing air flow. The Lockheed dive flaps are a solution to this difficulty throughout the tactical speed range of today's aircraft.

A New Gunsight Lead Computer

NEW gyroscopic gunsight "brains," which automatically "lead" enemy planes traveling at more than 400 miles an hour at ranges of more than 400 yards and at much higher angles of deflection than was possible previously, now are in mass production.

The new gyro "lead-computing" gunsight brain, which Bendix Aviation Corporation and the Eastman Kodak Company jointly adapted for mass production, is the American version of the British "Mark II-D" device which in a recent 6-month period enabled the Royal Air Force to double its destruction rate of German planes. The new sighting device is said to combine the most efficient qualities of previous reflector and computer gunsight types which have been under constant development by both the Army and Navy for several years.

Army's M-Dogs Detect Enemy Mines

THE Army is now using dogs to locate the deadly anti-personnel mines and booby traps set by the enemy.

The dogs who do this dangerous work are known as M-Dogs, the elite of the K-9 Corps. These canine specialists locate mine fields, lead the way around them, or point a safe path through them. They also indicate areas that are free of the death-dealing devices. As soon as M-Dogs locate mines or booby traps, the explosive devices are either removed or deactivated and the cleared areas marked with tape.

The Quartermaster Corps developed this mine-detecting method and began training dogs of its K-9 Corps for the work more than a year ago. Following the regular basic dog training, specialized training makes expert land-mine hunters out of the War Dogs. They are considered fully trained when they can carry out their mission over all kinds of terrain and in all sorts of weather. They have found and indicated to their masters the presence of mines that have been buried for weeks. They are especially proficient at indicating the presence of non-metallic mines, which defy the best mechanical detectors.

The M-Dog works on a 6-foot leash. When he discovers the presence of a mine or booby trap, he signals his find to his handler when at a distance of one to four yards from the concealed device. Each animal, however, invariably alerts at approximately the same distance each time, enabling the handler quickly to find and mark the exact spot of concealment.

New Gunsight Lamp Developed

A NEW gunsight lamp that enables American gunners to aim directly into the sun and yet fire with deadly accuracy recently has been developed for the Army and Navy. Protecting airmen against enemy planes which dive out of the sun to attack, the miniature lamp already is being produced for all types of optical gunsights as well as for torpedo directors.

The gunsights first used in this war allow gunners to aim within only about fifteen degrees of the sun, thus leaving a dreaded "blind spot." If the gunner aims more directly into the sun, he is unable to see his sight lines and has to fire almost blindly. With the new lamp illuminating his gunsight, the sight lines or "reticle" will be visible even against a glaring sun, and it will no longer be necessary to use a dark filter which tends to obscure the target.

A product of a year's research in Westinghouse laboratories, the new gunsight lamp also makes possible greater shooting

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Office of War Information photograph

Squadrons of bombers can take to the air more quickly because of Cletrac's help in moving, arming, fueling, and servicing them for another "Berlin Blockbuster." Every member of ground and flight crews really values the constant help Cletracs give their Buddies, the Bombers.

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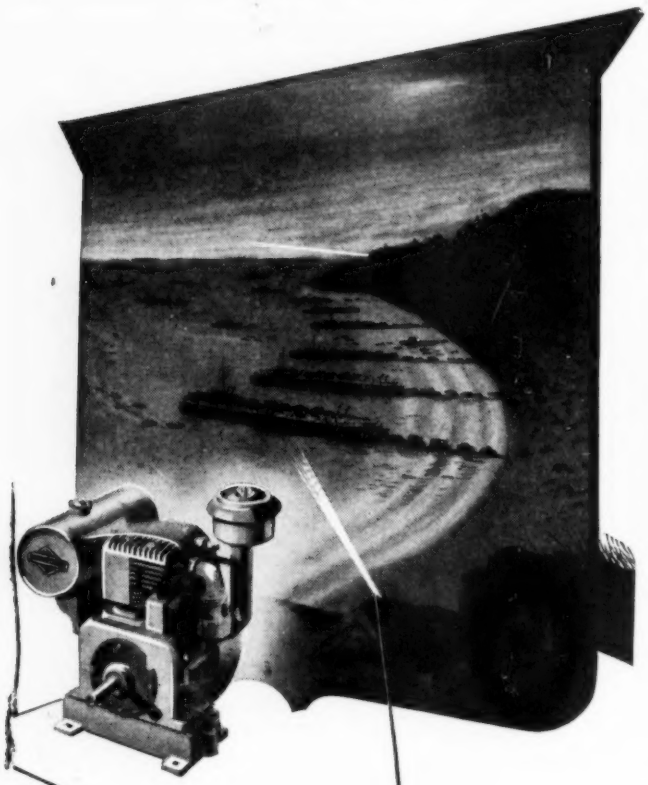

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New Developments

accuracy. No longer must the gunner glue his eye to an eyepiece in order to draw a bead on his target. Now his head can move an inch or two without impairing his aim. About the size of a walnut, the new lamp provides light from eight to thirty times brighter than gunsight lamps now in use and does so with the same filament wattage.

ORDNANCE SPARE PARTS SCHOOL

AT a unique school which trains soldiers in the highly specialized task of identifying the hundreds of thousands of parts which go to make up the Army's guns and equipment the two thousandth soldier-student recently completed the difficult course. This specialized course of study is conducted in the Parts Clerk School at the Rossford Ordnance Depot, Toledo, Ohio, operated by the Military Training Division of the Ordnance Department.

An original 8-week course to train parts specialists was later increased to twelve weeks and includes instruction in the identification of parts for small arms, artillery, vehicles, and instruments. Students specialize in two categories—Ordnance armament and Ordnance automotive. In addition they are sufficiently schooled in all parts work to such an extent that in an emergency they are capable of handling any type of part.

INNOVATIONS BY ORDNANCEMEN

THE ingenuity of Army Ordnance soldiers in Europe is not only helping our assault troops to thrust more deeply into Germany but will constitute a major contribution to American industry in the postwar period. By substituting a stamp fashioned from pieces of chamois cloth and blocks of wood for the stencil method of marking ammunition boxes, for example, members of an Ordnance unit are saving thousands of man-hours daily. The marking is done simply by dipping the stamp into paint and hitting the end of the ammunition box. When given a quick test in the field, the method proved much faster and cleaner than the stencil method.

Sgt. Daniel J. Macy of Brooklyn, N. Y., designed a gage which has reduced the time required for checking pistons on marine Diesel engines from fifteen to three minutes.

Tire-repair operations behind the front lines have been speeded up to such an extent that the operation to convert a worn tire into a serviceable one can be performed in three hours.

Tech. Sgt. Henry M. Beyreis of Ingalls, Kans., designed an adapter jig which returns to active duty one retooled tank engine master rod every ten minutes. These rods previously were scrapped because of the lack of available machinery to align and rebore the worn bushings properly.

Another Ordnance sergeant, Gerhardt Wiard of Sutton, Nebr., designed a high-speed tooling machine which turns out thirty-six refaced tank engine exhaust elbows every hour where formerly four were finished by tedious hand technique.

Tech. 5th Grade Martin W. Boxer of New York redesigned heavy grappling hooks used in conjunction with cranes in unloading the vast amount of Ordnance supplies daily arriving at a depot, thereby making it possible for one man to handle the hooks which are capable of lifting five tons. Corporal Boxer also drew plans for converting a ¾-ton weapons carrier to a full-fledged fire engine towing a trailer pump, hauling all the necessary fire-fighting equipment and carrying ten men.

Sgt. Elmer E. Johnson of Warren, Minn., designed a portable gasoline-operated water heater for use in Army evacuation hospitals. Among other innovations of Johnson's now in use at hospitals are surgical instruments that are not regular items or are impossible to obtain. His pet invention is an "Anascope" or "Protoscope" which enables an Army surgeon to observe accurately the lining of the large intestine.

Professional Digest

THE ROCK ISLAND ORDNANCE DEPOT ADVISORY COMMITTEE

COL. O. G. FEGAN

AT Rock Island Arsenal, Ill.—an old-line Ordnance establishment which for many years has been one of the mainstays of Ordnance weapons development and production—are many men whose entire business lifetime has been spent in the employ of the War Department. Many of these men know the design, engineering, manufacturing, and testing of weapons and their allied counterparts. Others know and have made a lifetime study of their distribution to the using organizations. It is with the men in the latter category that this narrative deals.

In setting about to rearrange inventories for faster supply action and to rewarehouse the entire depot which supplies over 100,000 separate items of issue, the necessity was seen for concerted action and well-planned administration of the over-all rewarehousing program. It was at the outset of executing this program that the organization of our depot operations advisory committee occurred.

Being somewhat new in character, the idea did not "catch on" immediately. One or two preliminary meetings were held in the office of the depot executive officer in order to acquaint the members selected to serve on the committee with the broad principles governing its work and to impress upon them the permanence of the group.

After the preliminary meetings were held, a formal letter of appointment, dated December 11, 1943, was addressed to each member, stating in part: "The duties of this committee will be to consider departmental operating problems and such other problems as might be presented from time to time to the committee for study and survey and to assist in formulating policies of operations," and further that "having spent the greater part of your lives in the service of the Ordnance Department you will be expected to 'carry on' after the present war is over. It is the combined teamwork, experience, and loyal devotion to your assigned tasks that is expected to make a very valuable contribution toward the successful operation of the Rock Island Ordnance Depot."

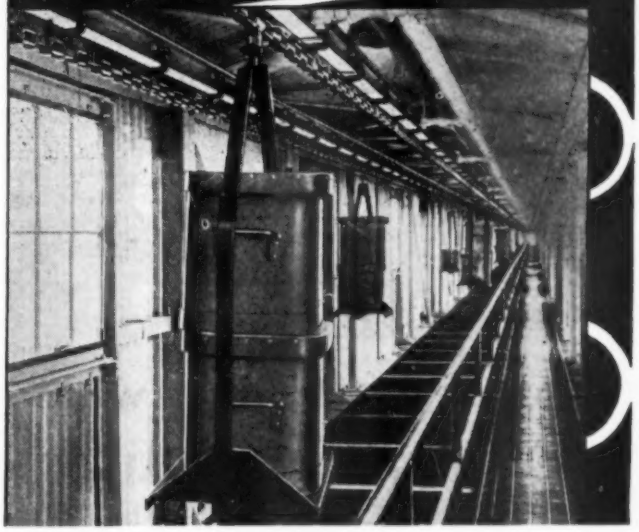
The acceptance was unanimous—all committee members signifying in writing their intention to serve. Depot-wide inventories, the first in some time, precluding the possibility of a January meeting, the first meeting was called to order on February 11, 1944. At the initial meeting it was thoroughly understood that the action of the committee would be advisory in character and execution, and that all suggestions and recommendations submitted would be placed in one of three categories: First, those that could be adopted immediately would be put into effect forthwith; secondly, those recommendations that required further consideration before they could be adopted; and thirdly, those recommendations that required "tabling" for future consideration. All phases of depot operation are represented by members of the committee—stock control, storage, maintenance, shipping and packing, matériel identification and coding, stock levels, and administration.

Each committee member is furnished with a binder which has a month-by-month tab index under which to file the proceedings of each meeting as held. This permits review and keeps the committee members informed on all past proceedings. Each meeting is reported in detail by a competent secretary so that an accurate record may be kept of all transactions.

The primary purpose of such a committee is to have these "old-timers" join in the management of the depot and articulate

Colonel Fegan is commanding officer of Rock Island Ordnance Depot.

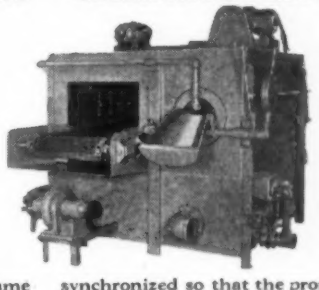
How to Handle Ordnance Materiel EFFICIENTLY!



THIS ALVEY-FERGUSON Engineered Trolley Conveyor with pendant-type carrier hauls filled containers from remote parts of the building—at the most practical handling speeds—and at uniform safely-spaced distances between containers, then returns empties to subsequent fillings.

"SIAMESE TWIN" CLEANING RACE

Always Ends in a Perfect Finish



This A-F Duo-Cleaning Equipment was built in the form of a "Siamese Twin"—with the Rotary Drum and Wire Mesh Conveyor Machines built side-by-side in the same housing and using the same set of pumps and the same supply tank.

Small parts are conveyed to this equipment in boxes covered with cutting oil. The parts and boxes are thoro-cleaned as they "race through" different sides of the equipment—which is synchronized so that the proper box always comes out first, in plenty of time to carry the same parts on to their destination . . . Have YOU a products handling or a metal products cleaning and finishing problem? We can help you. Write today.

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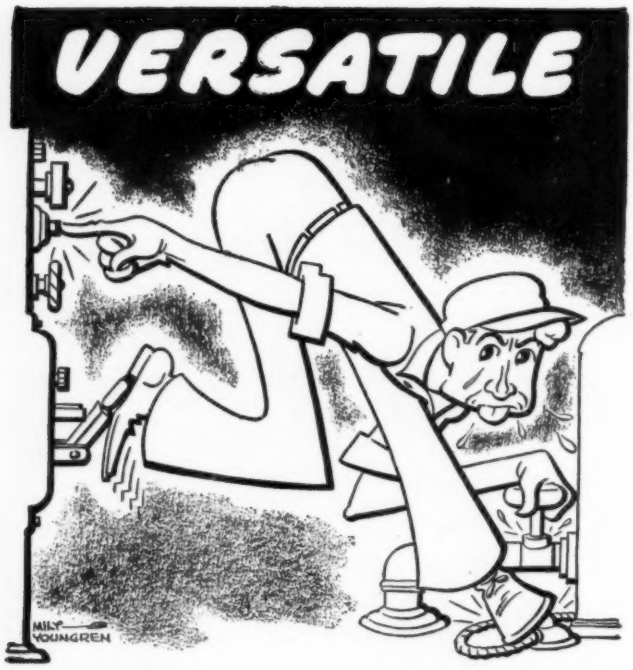

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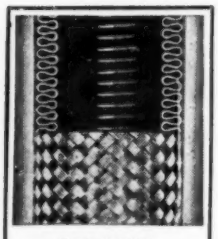

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Professional Digest

themselves to the topside management policies and programs, and to permit self-expression in the matter of recommended depot operation improvements.

Characteristics of recommendations made and adopted are: (1) The transfer of capable and highly trained depot personnel to the returned field stores section in anticipation of greatly increased volume of returned excess equipment due to inactivation of certain posts, camps, and stations; (2) The regular showings of appropriate and authorized motion pictures to depot civilian employees to increase activity and morale; (3) The organization and preservation of depot records, so as to be available for any required postwar reference; (4) A complete and thorough depot-wide inventory as soon as possible after the cessation of hostilities and the necessary subsequent adjustment of stock records to permit full accounting of disposition of all matériel handled by the depot during the war.

The following are members of the Rock Island Ordnance Depot Operations Advisory Committee with their years of Ordnance service indicated: W. F. Evans, 33; G. J. Porter, 32; J. S. Pemp, 29; C. A. Stoelting, 28; J. J. Lowry, 28; J. D. Frost, 27; F. W. Longacre, 27; Wm. Kendall, 26.

Considerable credit for improvement in depot operations at Rock Island Ordnance Center can be laid to the utilization of the latent management ability of these men who have made Ordnance supply a lifetime vocation.

The 120-mm. Antiaircraft Gun Mount

Edward J. Burnell

NOW it can be told that the mobile gun mount for the 4.7-inch (120-mm.) antiaircraft gun M1 was designed in the engineering department of Link-Belt Company at their plant in Chicago and that this took place before the Japs stabbed us in the back at Pearl Harbor. On December 28, 1940, Link-Belt Company was authorized to proceed with the design and detail of the 120-mm. gun mount T1 and the manufacture of two of these mounts.

On January 8, 1941, an initial group of six thoroughly experienced engineers started to work under the direction of G. W. Beatty, principal engineer on gun design, and G. W. Sullivan, ordnance engineer on recoil mechanism. In due course, this engineering personnel grew to an organization of approximately thirty men and was located in a separate department.

In July 1941, authorizations were given to the company to develop an electrically operated rammer for the 120-mm. T4 pilot. These development orders entailed the making of some 1,600 detailed drawings. This was not a job of designing a device similar to one already built, for there was no direct precedent to follow. It was a job that called for "original" thinking, with the knowledge that a complete wooden model was to be made as quickly as possible and that pilot models would then be built which would prove just how good the engineering was.

These pilot models, except the gun barrel (furnished by an eastern arsenal), were made by the company, and it was with a great deal of satisfaction that Link-Belt ordnance engineers and Army officials witnessed the initial tryout of the mechanism in the company's plant yard. Surprisingly few changes in construction were found necessary. These were subsequently made, as were a number of additional tests, followed by actual field trials at Aberdeen Proving Ground, after which the unit was officially accepted and ordered into production.

It is interesting to note that it took only one year to develop this entirely new gun mount—from "scratch" to the time of its acceptance at Aberdeen—and that this all took place prior to December 7, 1941.

Since the company's manufacturing facilities were not large enough to handle complete production of these gun mounts, the contract for their manufacture was placed with the Grand

* Mr. Burnell is vice-president of Link-Belt Company, Chicago, Ill.

Professional Digest

Rapids Stamping Division of General Motors Corporation. Link-Belt Company carried on the subsequent engineering developments and refinements and served as a subcontractor under the General Motors Corporation for the outriggers, bogies, drawbars, and the power-transmission equipment required for the rammers.

HEAVY ARTILLERY AMMUNITION

IN the article entitled "Heavy Artillery Ammunition," by Brig. Gen. R. E. Hardy, which appeared in the November-December 1944 issue of ARMY ORDNANCE, the National Tube Company was not listed among the principal prime contractors of heavy artillery ammunition. The company is a prime contractor for such ammunition and should be included in the list.

THE CARE OF SMALL ARMS

FEW American boys grow up without learning to "tinker," whether it be with radios, automobiles, or some other type of mechanical equipment. In normal life this is a habit to be admired and encouraged, and it has been a big help to the Army in finding men with mechanical abilities. But there are also occasions in the Army where tinkering is the cause of needless and costly damage to equipment. This has proved to be the case in the instance of small arms, for many soldiers are attempting unauthorized disassembly and repair of their weapons. The result is that too many weapons must be sent in to higher-echelon maintenance units for repair.

The damage that is done in this manner by the inexperienced soldier is almost unbelievable. For example, screw heads are ruined by the use of wrong-sized screw drivers or instruments never intended to be used as screw drivers. Setscrews, machine screws, and the like are changed without regard for interchangeability with the result that stripped threads render them useless. Parts of weapons are disassembled or assembled with force, which results in burring and damaging the parts. Care is not taken to protect disassembled parts, causing loss or damage to the parts. Tension or compression of springs is changed, trigger-pull action is modified, and damage usually results.

Modern weapons are manufactured by skilled technicians. Repairing them requires specific tools, the right amount of time, and practiced hands—and these essentials are seldom, if ever, available to the soldier in the field. There are only two services the soldier is authorized to perform on his small arms—cleaning and lubricating, including, of course, field stripping, in which no tools are required. The field manual for the individual weapon specifies just what may and what may not be done in performing these services. Therefore, it is the unit commander's responsibility to see that the instructions in these manuals are available to and learned by the soldier. The manuals, all in the 23 series, are listed in FM 21-6, and copies may be obtained from The Adjutant General's Office by presenting evidence that they are needed.

Cleaning and lubricating have been made as easy for the individual soldier as possible, so there is no valid excuse for failing to perform these services. The new rifle bore cleaner and preservative lubricating oil are both issued in handy, cigarette-pack-size containers which can be carried in a cartridge belt and thus be readily available for use at all times. And cleaning patches now come in small packs of twenty-five, wrapped in waterproof and dirtproof paper envelopes.

A rifle, carbine, or pistol that is always cleaned soon after firing and for three successive days afterward will keep its accuracy and dependability indefinitely. As far as the soldier is concerned, proper care, use, and handling are the only other requisites for effective maintenance.

HYDRAULIC PRESSES

Back the Attack

Watson-Stillman Press consolidating high explosives in projectiles at Mid-western ordnance plant.

Loading high explosive shells and armor-piercing bombs to help deliver the "knockout punch" to the Axis, Watson-Stillman Hydraulic Presses are at work night and day throughout ordnance plants and other busy war industries backing the attack.

Among these presses is the Watson-Stillman unit shown consolidating high explosives into projectiles at a Mid-western ordnance plant. This ammunition-making equipment takes its place beside many other Watson-Stillman Hydraulic Presses which are packing war wallops – some straightening gun barrels – some bending the keels of ships of our invasion fleet – others forming aircraft parts, re-conditioning railroad rolling stock, molding ceramics and plastic products, pressing powdered metal, extruding, forming and forging metals, and innumerable other operations. Write for General Bulletin 110-A.

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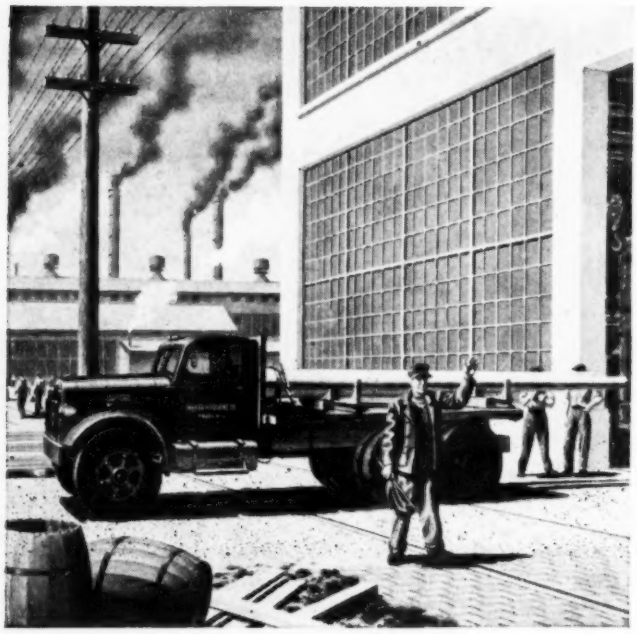

10 TONS
OF GUN TUBES

Heavy-duty hauling problems are best answered by Autocar—America's most famous heavy-duty trucks. At the Mesta Machine Company, Pittsburgh, Pa., Autocars haul five-ton, 155 mm. gun tubes, two at a time. Heavy loads and heavy going mean little to Autocar two-, four-, or six-wheel-drive trucks and tractors.

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Automotive Maintenance

Five Points for Trouble-Free Driving

Since the Army's requirements for automotive matériel continue to be extremely heavy, the following five major points in vehicle care and operation are currently being stressed, and both officers and enlisted men concerned with vehicle operation should be thoroughly familiar with them.

1. *Loading.*—It is imperative that transport vehicles be loaded properly to avoid damage from overloading and load shifting. Vehicles may be overloaded to advantage only if those in charge are aware of the dangers of abuse which overloading incurs. An overloaded vehicle must be handled differently from one with a normal load, no matter what the road conditions may be. Drivers must start and stop slowly and smoothly. Turns must be made with greater care. And where terrain is rough and hilly, speed must be reduced to ease the strain of jolting which may easily cause breakdowns when a vehicle is overloaded. Naturally, an evenly distributed load is essential in preventing damage.

2. *Engine Warm-up.*—This is a factor of vehicle operation which requires special attention due to the fact that racing a cold motor is a habit easily acquired when drivers are not alerted to its damaging results. This is particularly true when vehicles have air brakes and, in their impatience to get going, drivers race the engine to build up pressure in the brake system rapidly. Lubrication of pistons in a cold engine is never adequate and everything possible must be done to keep the damaging action of pistons against insufficiently lubricated cylinder walls at an absolute minimum. Warming up at too slow a speed is harmful because a slow warm-up requires excessive choking to keep the engine running, and the rich fuel mixture created by choking causes dilution of oil in the cylinders. On the other hand, warming up at high speed when there is no load on the engine is equally harmful, since proper lubrication is not provided under this condition. A fast idle (the equivalent engine speed of about 15 m.p.h. in high gear) should always be used to warm up an engine.

3. *Expert Driving.*—This is an accomplishment to which all drivers should aspire. Smooth starts and stops, silent shifting, careful maneuvering on grades and turns, and reasonable speed are all factors which contribute to the long life of a vehicle. Any amateur can drive a vehicle and eventually get where he's going, but it takes an expert to drive it without straining it to the point where mechanical difficulties set in.

4. *Choosing the Proper Gear.*—Drivers must be alerted to the importance of this phase of vehicle operation because of the fact that its abuse is not readily apparent. It should be remembered that straining an engine by keeping it in high gear at very slow speeds or by running at high speeds in lower gears is a sure way of damaging pistons, crankshafts, bearings, and other important working parts. The driver who thinks he is adhering to the rules when he descends a grade at the 35-mile-an-hour speed limit *in second gear* is mistaken. For at 35 miles an hour in second gear the engine is turning over at a rate of speed equal to around 100 miles an hour in high gear! Naturally this puts a terrific strain on every part. Drivers should know and comply with the permissible speed for each gear, as listed on the "caution" plate attached to every vehicle instrument panel.

5. *Daily Care.*—Little things like checking tires, lubricants, batteries, brakes, and cooling systems save big repair jobs. Performance of daily preventive-maintenance services listed on the back of the driver's trip ticket and preventive-maintenance service record (W.D. Form 48) is essential.

Book Reviews

LEE'S LIEUTENANTS—VOL. III: GETTYSBURG TO APPOMATTOX. By Douglas Southall Freeman. New York: Charles Scribners' Sons. $5.

THIS volume concludes Dr. Freeman's keenly analytical study of the higher command of the Army of Northern Virginia. To those who have followed his account from Bethel and First Manassas through Chancellorsville, the pleasure and enlightenment which will reward the thoughtful reading of this book will be tinged with regret that the study, like all good things, must end. And to those who have come to feel a personal friendship for the gallant band of leaders will come a sadness as, one after the other, they fall in the long months of bloody conflict. At last a bare handful reaches Appomattox, and then comes the harshest duty that can fall to the lot of any soldier—surrender.

The keynote of Freeman's writing, as always, is solid research. He is never content to copy or to follow. His own conclusions, no less than those of others, are subject to constant revision. As in the preceding volumes, new evidence on points of historical moment have been uncovered. Probably the chief of these have to do with Gettysburg, that subject of so many years of military controversy. At least some of the onus for the Confederate repulse, which for long has clung to General Longstreet, has been shifted to the dashing Stuart. That "happy warrior" of the Southern cause, stung by his recent humiliation at Brandy Station, led his cavalry entirely around the Army of the Potomac, more from a childish desire to "show off" than from the commonly accepted reason of his failure to understand Lee's detailed orders. Thus, blinded at the most crucial moment, Lee moved haltingly forward to almost certain disaster.

The arrangement of Volume III is quite similar to that of the first two volumes. A splendidly lucid foreword orientates the reader, and the familiar series of thumbnail sketches introduces him to the newer of the leaders. An abundance of excellent maps guides him in matters of topography, and a number of appendices add to his interest.

This reviewer ventures the hope, in which all friends of Army Ordnance will surely join, that Dr. Freeman, now that he has so brilliantly concluded this work, will turn his energies and abilities to the writing of a history of the ordnance of Lee's army. In this sadly neglected field his experience in Confederate research, his clarity, and his enthusiasm should ensure results that would gladden the heart of Freeman fan and ordnance enthusiast alike.

EDITOR'S NOTE.—Volume I ("Manassas to Malvern Hill") was reviewed in the January-February 1943 issue of ARMY ORDNANCE and Volume II ("Cedar Mountain to Chancellorsville") in the July-August 1943 issue.

RIFLES AND MACHINE GUNS. By Capt. Melvin M. Johnson, Jr. New York: William Morrow & Company. $5.

FIRST about the book: It is a comprehensive practical guide to important modern military small arms from the clip-loaded rifle to the 20-mm. automatic cannon. It is a fitting companion volume to "Automatic Arms" and "Ammunition" of which Capt. Johnson is coauthor. It describes and analyzes all the important United States and foreign weapons of World War II and describes their development, operation, method of loading, firing, and disassembling, with data on their ammunition, accuracy, and employment. More than sixty specific weapons are discussed in detail. In contradistinction to "Automatic Arms" and "Ammunition," this book analyzes modern small arms from the practical

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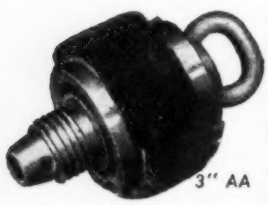
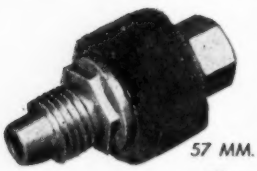
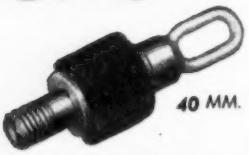
Made to Ordnance Specifications from 37 mm. up to and including 240 mm:



Above is shown the popular 155 mm. brush such as is used for the famous Long Tom Gun. Other size brushes are used for anti-aircraft batteries, tanks, and pack howitzers. Brushes are also provided for cleaning breech mechanisms and elevating gears.



Fullergript Brushes are made to Naval Gun Factory specifications from the one-pounder size up to the six inch gun.



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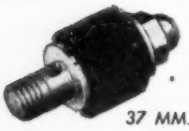

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Book Reviews

standpoint of use. The former volumes emphasize their theory and design.

About the author: He is well-known as the designer and inventor of automatic small arms including the Johnson semi-automatic rifle and the light machine gun. Brilliant as an arms engineer, he is also an intense student of small arms in all their phases in all countries and all decades. In addition, his fluent pen is accurate in description and entertaining in style.

Sampling Inspection Tables. By Harold F. Dodge and Harry G. Romig. New York: John Wiley & Sons, Inc. 106 pp. $1.50.

MASS production of many small parts makes the close inspection of each part prohibitive in cost. Sampling is then resorted to. The question is how many samples of each lot will give an approximately true picture? By means of tables, taking into consideration the tolerances to be met and the number of pieces in the lot, a sampling index can be found. The book goes into the mathematics involved and also gives a detailed outline of single and double sampling, together with the AOQL concept—the "average outgoing quality limit." The book is excellent for manufacturers and inspectors who want to set up a practical working system for sampling mass production.

In Abundance and on Time. Bridgeport: Remington Arms Company.

THIS is a record of Remington Arms Company's share in the production of small arms and ammunition for the armed forces of the United States and elsewhere. It tells the story briefly of what the men and women of Remington accomplished in the critical years from 1939 through 1943. The company has made arms and ammunition for the peacetime use and pleasure of generations of Americans. It has also helped in an essential way to arm America's fighting men.

When the need for small arms and small-arms ammunition became acute in 1939 the Ordnance Department turned first to the "old-line" producers of this small but vital industry. Remington was one of them. Within a minimum of time the company was operating huge plants at Bridgeport, Lake City, Denver, Ilion, Salt Lake City, Kings Mills, Lowell, and Findlay. The volume of production is staggering. Remington produced approximately the following portion of all small-arms ammunition in the United States: In 1941, well over fifty per cent; in 1943, forty-eight per cent; in 1943, thirty-nine per cent.

If there was ever proof of the accepted Ordnance doctrine that a small-arms industry in time of peace is vital to the welfare of the country in time of war, this little book is it.

The Ordnance Field Guide (Restricted—3 Vols.). Edited by Lieut. Col. William C. Farmer. Harrisburg: The Military Service Publishing Company. (Issued only by the Ordnance School, Aberdeen Proving Ground, Md.) $6.25 the set.

COLONEL Farmer, of the staff and faculty of the Ordnance School, has done an invaluable service to the Ordnance Department and to all students of armament by planning, compiling, and editing this 2-volume work. It contains approximately 1,000,000 words and 2,000 illustrations, charts, and pictures. The Guide satisfies a long-existing need for a manual of such broad scope that it could serve as an encyclopædic guide and self-educating text for Ordnance officers in the field.

Volume I deals with the broad aspects of the "Ordnance Service" and subjects with which the Ordnance officer in the field should be familiar, including military organization, recovery,

Book Reviews

evacuation, field rigging, troop training and movement, and maps and aërial photographs. Volume II covers technical and supply subjects on which all Ordnance officers in the field should be thoroughly proficient, including small arms, artillery and ballistics, fire control, aviation Ordnance, automotive, ammunition, and Ordnance general supply.

Some 200 Ordnance officers and enlisted men have compiled and written original manuscripts for the various sections of the manual, each of whom is a specialist in some particular phase of Ordnance operations or matériel.

Col. Farmer was assisted by Capt. John B. Scott, Ord. Dept., in the over-all and detailed planning, editing, and consolidating of the material for the Guide. Originally intended as a textbook of broad scope for training purposes, the work has emerged as a compromise between a textbook and a field reference guide due to the advanced state of ordnance training occasioned by World War II. As such it should serve as an authentic source of information for the duration of the present conflict and for some time thereafter.

Because of the nature of the subject matter, the "Ordnance Field Guide" is a "restricted" publication. Copies may be obtained only from the book store, the Ordnance School, Aberdeen Proving Ground, Md. Purchases made in writing by officers must be countersigned by the purchaser's commanding officer or by the adjutant. Purchases made in writing by enlisted men must be countersigned by the enlisted man's immediate commanding officer. All countersignatures must show the name, grade, and organization of the countersigning officer. Officers making purchases in person are required to present their identification cards. Sales to civilians will be made only to persons who have been certified under the provisions of AR 380-5 by the commanding officers of arsenals or other military establishments or district Ordnance offices.

The Guide may be purchased for $5.00 for the complete set if orders from within the continental limits of the United States are postmarked prior to February 1, 1945, and orders from outside the continental limits are postmarked prior to March 1, 1945.

Royalties from the sale of the book will be donated to the Army Emergency Relief Society.

AMERICAN TANKS AND TANK DESTROYERS. By Elizabeth Mallet Conger. New York: Henry Holt & Company. $2.

THE author of "American Warplanes" has produced another unusual book in this Junior Literary Guild selection. Here are the facts about the vehicles and weapons of our armored forces, the training of the men in the armored command, and the way that training is used in actual battlefield maneuvers.

From a strictly Ordnance point of view, the author has narrated an accurate and comprehensive account of our principal tanks and armored vehicles. Hers is not the technical type of writing for the engineer but the popular type for the average citizen whose interest will be held by all that is here described.

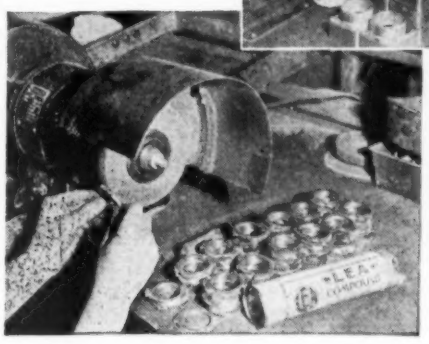
MILITARY LAW FOR THE COMPANY COMMANDER. By Julian J. Appleton. Washington: National Law Book Company. 141 pp. $2.50.

THE company commander is in closer contact with the enlisted man than any other officer in the Army. He is constantly being called upon to render decisions that will affect the morale of his men. He must not be too lenient or too harsh but must strive to strike a middle ground that will achieve discipline and yet not destroy the *esprit de corps* that is so essential. In most cases he is not a lawyer, and yet he must be familiar with some of the fine legal definitions in violations of the various Articles of War.

The text tells the company commander when he should ad-

LEA is very much in the picture at JACK & HEINTZ

BURRING
and
BUFFING
JAWS
CONNECTORS
GEARS



Recently we were awarded the Army-Navy "E" for work done in the important field of finishing . . . for the production of burring, polishing, and buffing compositions . . . for technical help in aiding war contract companies to work out fast, efficient methods.

No better example of this very service can be found than at the Jack & Heintz plant in Cleveland where LEA is very much in the picture. This company had war contracts that called for the best in production methods. LEA Technicians help them work out efficient finishing operations and then provided the proper grades of compositions. Jack & Heintz is a steady user of LEA Compositions.

First the proper method; then the proper grade of LEA COMPOUND or LEAROK to carry out the finishing operations—this is the essence of the LEA Service to plants with burring, polishing, or buffing problems.

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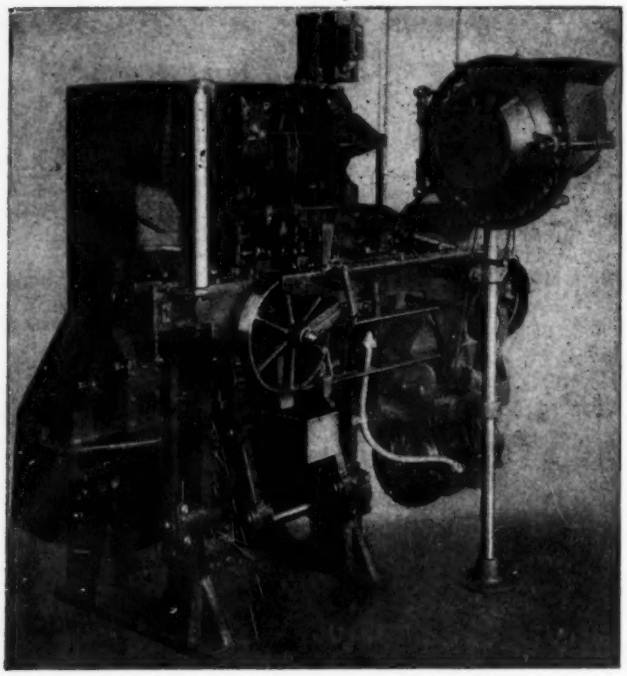
SMALL ARMS
AMMUNITION
MACHINERY



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For Caliber .45 Cartridge Cases

One of our large family of Small Arms Ammunition Machinery. This line is the outgrowth of long experience in the development of machinery for the mass production of bullets, cartridge cases, etc., and the handling of explosives.

While the equipment is used extensively in U. S. Government Arsenals, the line includes also various machinery adapted to the manufacturing practices of England, Canada and other foreign countries.

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Book Reviews

monish, reprimand, or punish the offender. It takes up in detail the punitive Articles of War, citing each article in turn and then by examples shows how the offender should be charged and gives the specifications in detail. The complete samples of specifications, table of maximum punishments, and cross index make this an extremely valuable book for any officer.

Reveries on the Art of War. By Marshal Maurice de Saxe. Edited by Brig. Gen. Thomas R. Phillips. Harrisburg: The Military Service Publishing Company. $1.

First published in 1757 and translated into English the same year, this text has long served as a reference work for military students. Its appearance at this time adds in pleasing format a volume which underlies many other treatises now being published on more advanced phases of the Marshal's basic text. It has long been the subject of favorable comment by military critics.

A Guide to Naval Strategy. By Bernard Brodie. Princeton: Princeton University Press. 291 pp. $2.75.

Strategy on a world-wide basis in unison with other important allies, and during a period of years in which battle equipment changed rapidly, is not something that can be set down in a few formulas. The author, therefore, has taken his first edition published in 1942 and has revised it to cover naval actions through the invasions of Saipan and Normandy. This period includes the final stages in the conquering of the menace of the submarine raider, and also brings many added facts together for the settlement of the old argument of battleship versus airplane.

The author has written a comprehensive general guide to what has really happened, with penetrating and calculated evaluations. He has ridden no popular hobbies and taken no sides, nor does he try to prove victory through air power.

The book treats of each type of equipment, from freighter to battleship, and the use of armament. It covers the command of the sea, the defense of shipping, land-sea operations, and the men who make up the fleet. It is a volume that the layman as well as the naval officer will find interesting and instructive.

Books Received

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